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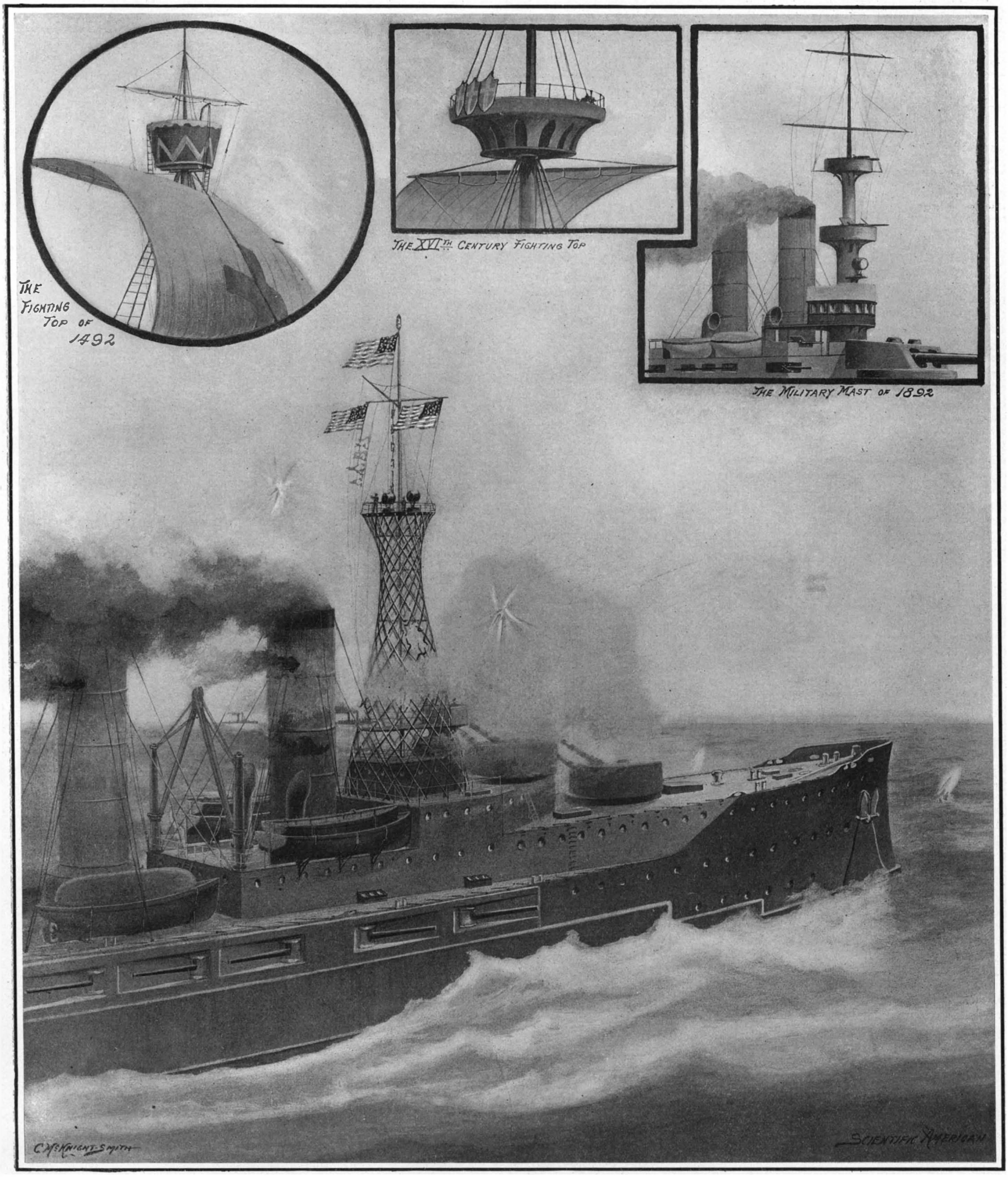
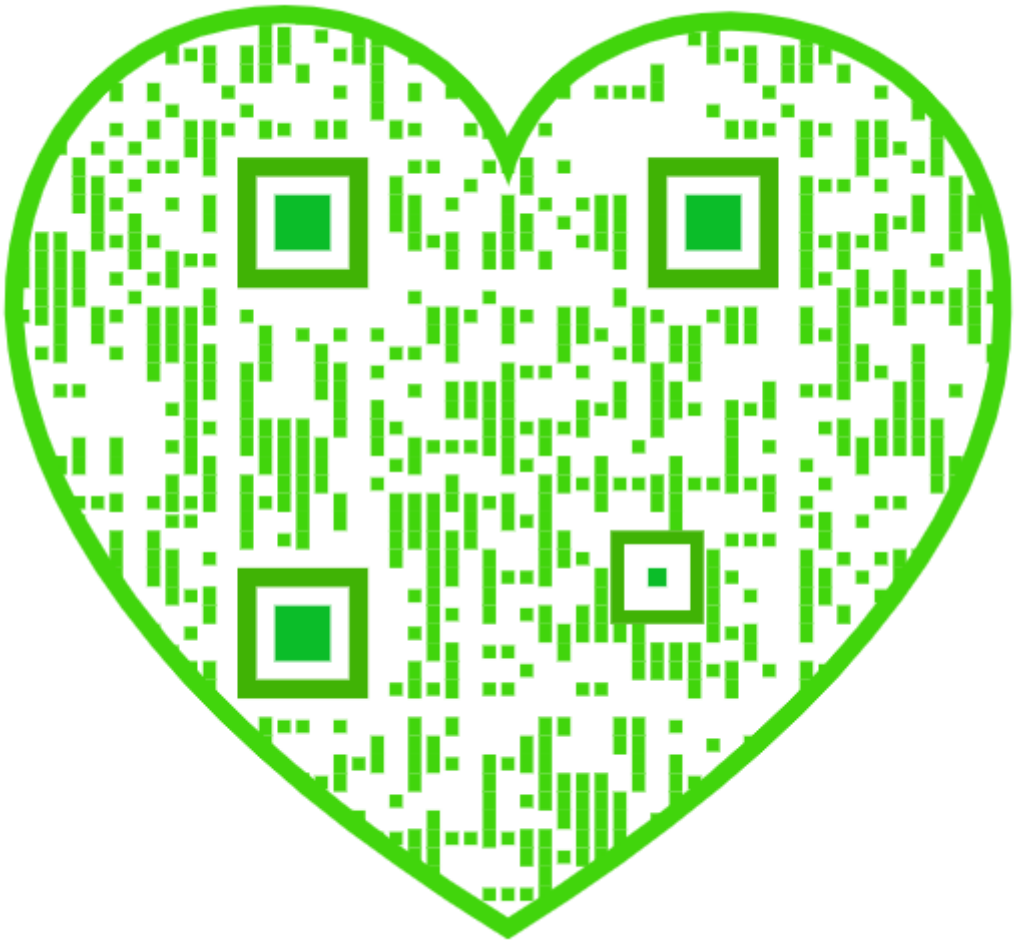


During the past four hundred years the fighting top has developed from a large armored position carrying cannon and many fighting men to the simple observation platform at the top of a spiral tube mast.

FIGHTING TOPS PAST AND PRESENT.—[See page 336.]



SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, NOVEMBER 14, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ACCURACY AND UNIFORMITY IN ELECTRICAL STANDARDS.

The purchase and sale of electricity for power and light are matters of such every-day importance, that to define in clear and unmistakable terms the quantities by which current is measured commercially as well as scientifically would seem a most necessary duty. These quantities depend upon fundamental units, whose definitions must be stated with scientific accuracy and precision. It is for this reason that the International Electrical Conference, which assembled at London on October 12, possesses an interest which transcends that of most learned bodies. While it was not the object of the conference to formulate laws, yet by making certain definite recommendations for the legal definition of the units, and for their practical realization at national and other laboratories, progress was made toward a uniform system of international standards. In electricity, as distinct from weights and measures, there is not only a single and logically evolved system, but a substantial harmony of electrical units and standards among the civilized nations of the world. Scientists and testing bureaus co-operate to achieve accuracy and unanimity in the definition and reproduction of electrical units. Of such accurate definition of the fundamental units there has been a constantly increasing need. As Prof. Warburg, a German delegate to the recent conference, stated, the practical units of current and voltage have been realized with an accuracy that has tripled in the last three years.

With precision of definition and construction of standards comes of course greater uniformity of practice in both science and industry; and the recent conference was called to clear up doubtful questions and to bring about a desired uniformity. It hardly could be expected that recommendations of a novel or radical character could be adopted; yet at the same time, from the general discussion and the resolutions passed, it is apparent that something was accomplished, and that in the future a greater and more general uniformity will ensue. The resolutions of the conference, it must be understood, must be reported to the nations participating, and be duly legalized just as in the case of standards of length and capacity. While the resolutions decided that the magnitude of the fundamental electrical units should be based on the electro-magnetic system of the Centimeter-Gramme-Second system, and that the ohm, volt, and ampere should be defined in terms of this system, yet, as a system of units representing the above, and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, there was recommended the adoption of the international ohm, the international ampere, and the international volt, which were duly defined.

In discussing the definitions, considerable difference of opinion developed, as was anticipated. Naturally, the ohm was taken as the first primary unit, and it was defined as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross sectional area, and of a length of 106.300 centimeters, the resistance to be determined according to precise specifications. A proposition to make the length of the column exactly one meter and correspondingly cut down the mass of the mercury was resisted, on the score that the ohm, like the prototype meter and kilogramme, should be fixed and unvariable and not subject to adjustment, though of course the true standard could be determined from time to time with all possible precision. Despite the opposition of the American delegates, the ampere was taken as the second fundamental unit, and was defined in terms of a mass of silver (0.001118 gramme) deposited in a second, and the volt was defined in terms of the ampere and ohm. A definition of the watt as the unit of power with the value 10,000,000 in terms of the C. G. S. system, or the energy expended per second by an unvarying current of one international ampere under an electric pressure of one international volt, was passed.

Of equal interest were the recommendations for realizing these definitions by giving the specifications for working methods. For the ohm there is the detailed description of the mercury column and its use. For the measurement of current, a current balance is standardized by comparison with a silver voltmeter, or by the use of a Weston normal, or saturated cadmium cell, whose electromotive force had been determined in terms of the international ohm and ampere and of a resistance of known value in ohms; and finally the international volt is to be determined by the difference of potential of a coil or by the use of a Weston cell whose E.M.F., when set up according to specifications, is provisorily accepted as 1.0184 volts.

The conference recommended that the best method of securing future uniformity would be the establishment of an international electrical laboratory independent of any national laboratory or bureau, whose duties would be the keeping and maintenance of the electrical standards, in much the same manner as the International Bureau of Weights and Measures, which with its laboratory at Sevres near Paris has exerted such a valuable influence on science and industry. As the realization of such a proposition would be a diplomatic rather than a scientific undertaking, it was decided to establish immediately a permanent committee of fifteen scientific men, to be appointed by Lord Rayleigh, the president of the conference, to advise as to its organization, and to supervise any new work or matters unfinished by the conference. This committee is also to consider the important question as to whether the powers and functions of the International Conference of Weights and Measures could not be enlarged, so that under its most efficient organization electrical laboratories and investigations could be maintained and administered in preference to founding a new international institution. At the same time, however, it was the opinion of the conference that the proposed permanent committee should be retained as a distinct body, which should meet at different places in succession. The taking over of work on the electrical standards by the Bureau of Weights and Measures, as has been proposed, would be a most excellent measure; for it has been of the greatest usefulness, both to the nations supporting it and to the scientific world in general. In any event, the spirit of international co-operation as regards electrical units and standards has been so manifest in the past, that the measures proposed by the conference without doubt will lead to a greater uniformity, as reflected in the laws and practices of the civilized nations of the world.

THE TACTICAL VALUE OF TORPEDO CRAFT.

The United States navy has under construction four torpedo-boat destroyers of 902 tons full-load displacement, and Congress at its last session provided for ten more vessels of this general type, which will probably be between 1,000 and 1,200 tons full-load displacement. We also have under construction eight submarine boats, ranging in displacement from 274 tons to 500 tons when submerged; and Congress at its last session authorized the building of eight more submarines, at a total outlay of not more than $3,500,000. These boats will probably have displacements of not less than 400 tons when fully submerged. As can be seen, the "destroyers" and the submarines represent a very material increase to our torpedo craft, and the question is: In the light of experiments and maneuvers abroad, which type, the surface or the underwater boat, is likely to give us the better defensive return for the money expended?

Apart from the unquestionable offensive powers of the torpedo, *per se*, modern developments in the form of turbine propulsion, superheaters, and more accurate gyroscopic gears have added very materially to the range and the directness of travel. As a result, both the 18-inch and the 21-inch torpedoes have much longer effective ranges; the 18-inch being able to run 1,800 yards at a speed of 35 knots, while the 21-inch torpedo is able to cover a distance of 4,000 yards at a speed of from 26 to 27 knots. Searchlights as now installed upon modern naval vessels cannot be safely counted upon to pick up a low-lying torpedo craft at a distance of much over 1,500 yards, and it is therefore plain that the modern torpedo outranges the reach of the searchlight. Surface torpedo boats and destroyers are not exclusively designed for the use of torpedoes. Each of them carries a fairly considerable armament of rapid-fire guns, and it is evident that their torpedoes are essentially instruments of opportunity, and that that opportunity can come chiefly at night, and then under conditions more or less limited.

Extensive experiments conducted abroad have proved the utter impracticability of a successful daylight attack; the torpedo vessels being theoretically destroyed by the rapid-fire guns long before getting within torpedoing range. Accordingly, night attacks have become the object of most serious study, and with some measure of success.

During some recent maneuvers in the British navy, a problem of this sort was set the division commander of a flotilla of torpedo destroyers: A squadron of cruisers and battleships was sent to sea at night, and a division of destroyers, not informed of the whereabouts of the ships, was ordered to hunt them down and to attack them by means of torpedoes with collapsible heads. The torpedo was to be considered properly fired only when it had struck the hull of a designated ship; the captain of each torpedo craft being obliged to name the vessel chosen by him for attack, and to identify his vessel before firing the torpedoes. The net result of this experiment was that the torpedo boats discovered the vessels and were able to make their attack before their presence was observed by the battleships and cruisers, but not a single torpedo struck home, and no commander was able to state which of the enemy he had endeavored to hit. In order to strike a moving target, the torpedo must be so aimed that due allowance shall be made for the enemy's speed and the direction in which he is moving. These two elements in the triangle of fire are hard enough to estimate in broad daylight, and the difficulty is accordingly magnified by darkness, while atmospheric conditions and any dimness of light will make it hard to identify even well-known vessels. The results in the foregoing maneuvers need occasion no surprise, but they do point significantly to the desirability of securing some means of getting within torpedoing distance within the ranges of daylight, when the probabilities of successful attacks give ample reason of being for torpedo vessels. It is thus seen that the surface torpedo boat is practically denied the chance of doing effective service during the daytime, while at night, except under limited conditions, she is a menace to both friends and foe, unless by some rare chance she be able to get safely within striking distance, and then to make sure that her target is the right one. The blinding effect of the searchlight is all too well known, and with a watchful foe so guarded, the opportunities of reaching a moving enemy are few and far between, because her speed and direction of motion can only be guessed at roughly.

The submarine torpedo boat seems to be the logical solution of the problem. Of course, their problem is the same as that of the surface boat, so far as properly calculating the direction in which the torpedo shall be aimed in order to compensate for the rate and direction in which the enemy is moving; but this is capable of solution through the medium of a proper observing instrument or periscope, and, again, this is an optical task which the Italians are said to have successfully accomplished.

Undoubtedly, underwater boats of the future will be divided into two broad classes; those for harbor and coast defense in the more restricted sense of the terms and those for offshore or seagoing purposes; the mission of the latter boats being not only to keep an enemy well to sea and beyond bombarding range of their guns, but also to accompany a battle squadron at a good cruising speed, and constitute its outlying defense when those ships are anchored in an unfortified port or improvised coaling base. Upon the resumption of the squadron's cruise, the submarines will be discharged of their duty of defense, and follow along in the rear of the big ships. Such would be the principal services of the seagoing submersible of displacements ranging from 300 to 600 tons, while the boats for strictly harbor and inshore protection would be craft of 200 tons or less, capable of holding their positions submerged for a maximum period of probably twenty-four hours. The seagoing submersibles would naturally have to have speeds of fully 15 knots an hour upon the surface, and a cruising endurance at a 10-knot clip of quite a thousand miles. This is not calling for anything extraordinary in view of what has already been accomplished.

Reviewing these conditions in the light of the most recent experience abroad, may it not be justly claimed that we would do wiser by adding more to our flotilla of submarine vessels, and making of our destroyers craft of much larger displacement, so that they may properly serve the purpose of "scouts," for which a field of valuable daytime service does exist; making their torpedo equipment of secondary importance, and recognizing their chance of possible usefulness to be that of a remote opportunity?

ENGINEERING.

New South Wales has reason to be proud of the fact that during the past seven years out of a total number of passengers carried on her railways of 258,620,836, only one has been killed in a railway accident.

Bronze medals are to be presented by the President to employees of the Isthmian Canal Commission who have served two years or more on the Isthmus. The medals are to be cast from metal collected from old French excavators, locomotives, and cars found on the works by the United States government when they took possession of the canal.

Great as is our coal production, it continues to show a large annual increase, the total amount of anthracite and bituminous coal mined in 1907 amounting to over 480,360,000 short tons. To transport this product in trains made up of thirty cars of 50 tons capacity, would call for 320,300 trains, whose combined length would extend two and two-third times around the world at the equator.

The pay-as.you-enter cars possess other advantages besides that of securing fares which are ordinarily lost to the company. It is reported that the introduction of this type on the Chicago City Railway has reduced the number of fatal accidents by over sixteen per cent. It has also reduced the number of less serious accidents due to getting on and off the car.

With a view to preventing the driving of automobiles at high speed across the tracks at grade crossings, the Long Island Railroad Company have arranged with the Long Island Automobile Club to have hummocks formed in the road on each side of certain grade crossings where reckless driving has been most common. There are altogether 429 grade crossings on the Long Island system, and the number of fatalities has grown to an alarming extent.

The old Sandy Hook Lightship which for more than fifty years has marked the entrance to the channel leading to New York harbor, will end its useful service on December 1, this year, when its place will be taken by a new lightship which will be known officially as 87 Ambrose Channel 87. The Lighthouse Bureau in Washington has decided that the importance of the new deep waterway into New York harbor is such that the ship marking its entrance should also bear its name.

There will be some sentimental regret expressed over the decision of the Navy Department to change the color of our future warships from white to a dull gray. The first battleship is to be so painted will be the "Maine," which has just returned from her cruise around the world. Slate gray, the universal war color, is adopted because of its comparative invisibility. The custom of painting warships white is costly, because the frequent coaling of the ships quickly mars their appearance and necessitates frequent repainting.

Some four years ago, when the construction of the Hudson River tubes was begun, the Erie Railroad Company employed a board of experts to report on the advisability of electrifying the suburban lines of the company. They estimated that the whole suburban system could be electrified and operated at a profit at a cost of $14,000,000. The scheme is now likely to be carried through by the aid of the powerful financial interests which have recently come to the assistance of the road. The completion of this scheme will bring a long-sought and greatly-needed relief to commuters who use this system.

We are informed by the Pennsylvania Railroad Company that an examination of their records for the past three years shows that the best performance made by a regular train between Jersey City and Chicago was that of the eighteen-hour special, which, on November 3, 1905, left on time, arrived at Harrisburg 1 hour and 36 minutes late, being delayed by a freight train, and arrived at Chicago only 3 minutes late, having made up 1 hour and 33 minutes on its regular schedule of eighteen hours. The entire run of 912 miles was made at slightly over 55 miles per hour; but most of the time was made up between Harrisburg and Chicago, a distance of 724 miles. The total time of the run was 16 hours and 24 minutes.

Although the various projects for the construction of a railroad bridge across the Hudson River have been abandoned, it is not improbable that a highway bridge for automobile, trolley car, and general vehicular traffic will be built at a site located near the upper end of Manhattan Island, where it will be possible to find a location at which the piers of the structure can be brought much nearer together than is possible lower down the river. If the main span could be shortened and the terminals be located where the cost of real estate is not prohibitive, the successful financing of such a structure should present no insuperable difficulties. A joint Bridge Commission, representing the States of New York and New Jersey, which has the matter in hand, has tentatively proposed the location of the crossing at 117th Street in the Harlem district.

ELECTRICITY.

The rack and pinion railway of the Interlaken-Lauterbrunnen-Wengern Alp-Grindelwald is being converted to electric traction. A direct-current overhead trolley system will be used. This change to electricity is made possible by the abundant water supply from the glacial areas.

The Illinois Central Railroad has recently announced that its terminal in Chicago is to be electrified. This is considered an important victory for the public in their agitation against the smoke nuisance. It is estimated that the cost of electrification without power generation will amount to nearly $4,000,000.

Nearly 300 miles of line for power transmission purposes is to be put up by the Ontario Hydro-Electric Power Commission in order to supply various towns and cities in Ontario with electricity generated at Niagara Falls. About a million pounds of aluminium wire will be used. The line will consist of three cables supported on towers spaced 550 feet apart.

Application for permission to acquire the Tyin and Matre watercourses in western Norway for the development of 60,000 to 70,000 horse-power has recently been made by a German company. The power will be employed for the production of chemicals, for the reduction of iron ore and for other industries. At the expiration of seventy-five years both plants will revert to the government.

Two storage-battery railway cars are now in use on the Prussian state railways. These are the first of 57 such cars which will soon be in service. The cars can run 60 miles without recharging. They are arranged in pairs, each member of a pair being furnished with an 80-horse-power motor and a battery of 84 cells, which is carried in front of the motorman's compartment.

Emigration to the cities and the cost of maintaining draft animals during idle times are two potent factors which have contributed to the use of power machinery in agricultural operations in Germany. German farmers have found it economical to introduce many electrically-driven machines, such as plows, mowers, harvesters, threshing machines, beet-pullers, weeders, etc. In the dairy, as well, the electric motor is used to drive the machines.

An electrically-propelled ferryboat has recently been put in service on the Rhine. This vessel is provided with twin screws which are driven by a pair of 50-horse-power interpole series motors. The electrical energy is supplied by a storage battery of 160 cells. In addition to the two driving motors there is a pair of motors used for operating the gang planks and another motor for operating a pump. At each side of the river facilities are provided for charging the battery.

Lifting magnets are being used quite extensively in some of the large machine-tool plants of the middle West. These magnets are not only employed for handling iron and steel castings, but also for cleaning up the small particles of metal from the floor or even from the yard around the plant. They are suspended from locomotive cranes and moved about the yard close to the ground. The amount of steel and iron they collect is astonishing. Often pieces that have mysteriously disappeared are resurrected by the magnet, sometimes showing that they were purposely buried to hide mistakes of the employees.

The first of the four locomotives which are to haul trains through the Cataract Tunnel of the Great Northern Railroad is now being severely tested. The locomotive is of the double-truck type. Each truck is fitted with two motors which are of the three-phase induction type. The locomotive has an over-all length of 45 feet, with a rigid wheel base of 11 feet, and its total weight is 230,000 pounds. It is equipped with four trolleys, two of which are used in each direction, the rails serving as the third conductor. The current will be supplied at 6,000 volts and will be transformed in the locomotive to 500 volts. The Cataract Tunnel is nearly three miles long and has a uniform grade of about 1.7 per cent. The locomotive is designed to give a speed of about 15 miles per hour up grade.

For the past year one of the large German steel works has been using the electric furnace on a large scale for producing cast steel for automobile and other machine parts. The reason for the change from the crucible furnace to electricity is the fact that the cost of fusion could be materially reduced without lowering the quality of the steel. The Stassano system of electric furnaces is used and the furnaces are charged with from 400 pounds to 10 tons of metal. The carbon electrodes terminate slightly above the surface of the metal, and a concave dome reflects the heat that radiates upward. Mixing is effected by mounting the furnace on a slightly inclined axis, when the rotation of the furnace causes the lower part of the molten mass to rise to the top, thoroughly mixing the material. Fusion requires 3½ hours, and an hour and a half more is necessary for the removal of phosphorus and sulphur.

SCIENCE.

A bulletin issued by Harvard College Observatory says that Prof. E. B. Frost, director of the Yerkes Observatory, calls attention to the recent increase of brightness of Morehouse's comet. He writes on October 29: "The comet on that date was visible to the naked eye, and three or four degrees of tail could readily be seen in a small field glass. Three spectrum plates were obtained at Yerkes. Two of these had exposures of one hour. No continuous spectrum was perceptible on the date mentioned. Hence the important inference is reached that the comet's light was very largely intrinsic. Seven bands were very conspicuous as knots on the plate."

The ancient Greeks recommended the use of sterilized water. In the first century of our era Rufus of Ephesus wrote: "The water of all ponds and rivers is bad, except that of the Nile. Stagnant water and the waters of streams which traverse unhealthy lands or pass near public baths are unwholesome. The best water is that which has been boiled, in vessels of earthenware, allowed to cool, and heated again before drinking." For armies in the field the following method of purification is recommended: "A series of pits extending from the highest to the lowest point of the camp, should be dug and lined with the soft unctuous clay of which pottery is made. The water is caused to flow successively through these pits, which retain all the impurities." It is remarkable that neither of these methods was deemed necessary in the case of the water of the Nile which, although the microscope shows it to be safe, is apparently the worst of all and looks like very muddy Sauterne.

At the last meeting of the scientific commission of the Aero Club of France, M. Decuzis presented a report of an ascension made on July 3, 1908, in which the great altitude of 17,500 feet was attained. At the highest point the temperature was 53½ deg. F. and the hygrometer indicated a relative humidity of 27 per cent. Dr. Crouzon gave an account of the physiological observations made by him and Dr. Soubies in the course of the trip. One of the passengers was attacked by "balloon sickness" at an elevation of 13,300 feet, but was readily relieved by the administration of pure oxygen furnished by the Guglielminetti apparatus. No regular effect of altitude upon arterial pressure was observed, but a marked progressive diminution of muscular strength with increasing altitude was recorded. Cutaneous sensibility, measured with the Weber compass, diminished slightly and a similar effect upon the acuteness of hearing was detected with the Bonnier diapason. These experiments will be repeated and extended in other ascensions to great altitudes which will soon be made by the commission.

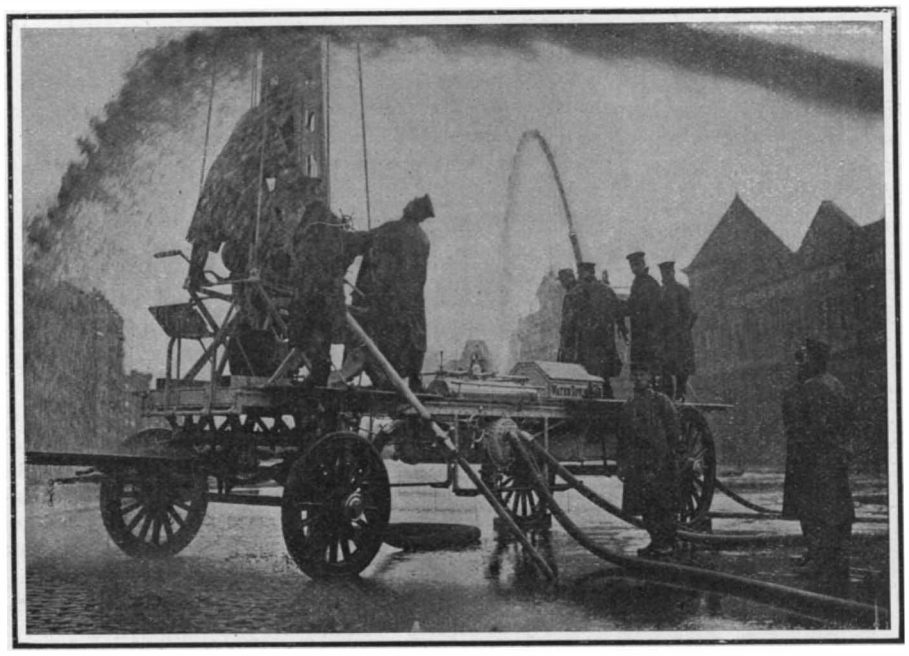
David Starr Jordan, president of Stanford University, spoke before the Trans-Mississippi Congress on "International Fisheries Commission." Dr. Jordan described the Commission as an interesting effort "to settle at once a number of problems in international law, in constitutional law, in conflict of laws, in equity and at the same time in biology." No statute for the preservation and propagation of fish can be effective, he said, unless the nature of the individual species, its food, its distribution, and its habits, is primarily and persistently kept in view. He reviewed the efforts to regulate the American and Canadian fisheries, and said it had been agreed to submit a code to both nations in January, 1909. The artificial propagation of fish, the development of the fish hatchery, said Prof. Jordan, was the real solution of the problem. It was an art rather than a process and, like all arts, it must rest on science. He described various species of fish and sounded a note of alarm concerning the salmon fisheries of the Columbia River.

Several French sugar manufacturers have been making experiments in regard to the possible addition of sugar to bread, with the object of creating a new market for French sugar which, since the Brussels convention, cannot be sold profitably in foreign markets. Dupont observes that the total consumption of sugar would be very largely increased by its addition to bread in so small a proportion as five parts to the hundred. It is a curious fact that the flavor of bread containing 5 per cent of sugar cannot be distinguished from that of ordinary bread. Bread does not taste sweet unless it contains at least 10 or 15 per cent of sugar. The sweet taste is agreeable to some consumers, but not to all, and difficulties are encountered in making and baking bread which contains so large a percentage of sugar. Hence it is not advisable to add more than 5 or 10 per cent of sugar. At the last congress of chemists, excellent bread made according to Dupont's formula was exhibited, and bread containing sugar has been experimentally used, with success, in the army. Sugar possesses a high food value and is perfectly assimilated, and an increase in the consumption of sugar would be of great benefit to the farmers of northern France. In 1907 the consumption of sugar in France amounted to 581,000 tons, or about 33 pounds per capita.

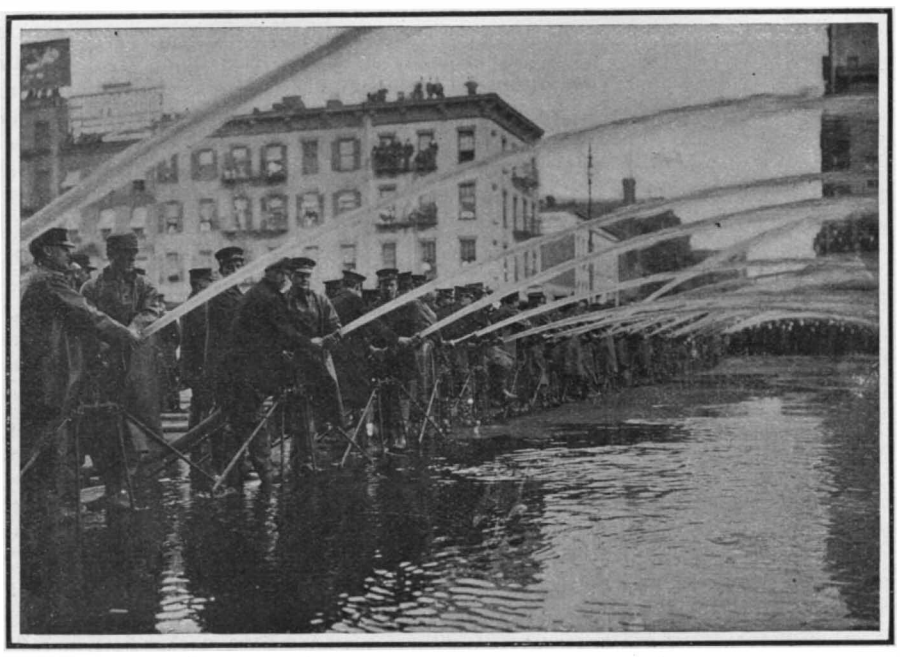
SUCCESSFUL TEST OF NEW YORK'S HIGH-PRESSURE FIRE SERVICE.

BY HERBERT T. WADE.

New York's high-pressure fire service has been in successful operation since July 6, and has proved so useful that recently there has been appropriated $1,800,000 for its extension on the lower east side, where there is the greatest conflagration danger, and where owing to the congestion of population a deplorable loss of life would doubtless occur in any large fire. In addition to its actual employment at a number of small though serious fires, several extensive tests of the system have been held since its completion.



Siamesing the high-pressure hose lines for the high nozzle and deck pipe of the water tower.

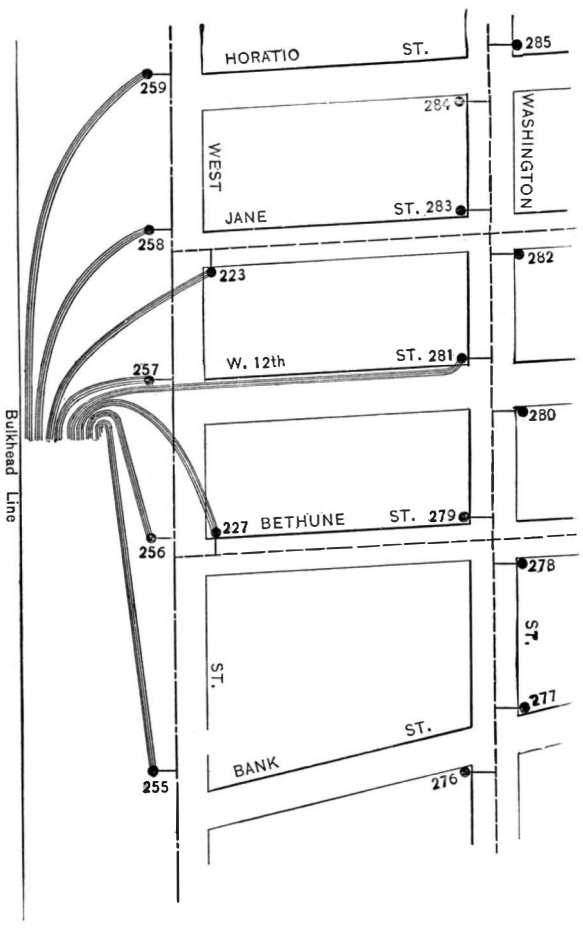


Using the spider-legged nozzle holders in a test of the high-pressure fire service in New York.

The substitution of two central pumping stations with electrically driven centrifugal pumps for a number of portable steam fire engines marks a radical departure in fire fighting, for not only must there be used large and heavy hose to withstand the great pressures of the powerful stationary pumps, but the pressures at the nozzles are so great as to render the efficient directing of a stream of water a difficult if not impossible matter without the aid of some auxiliary contrivance.

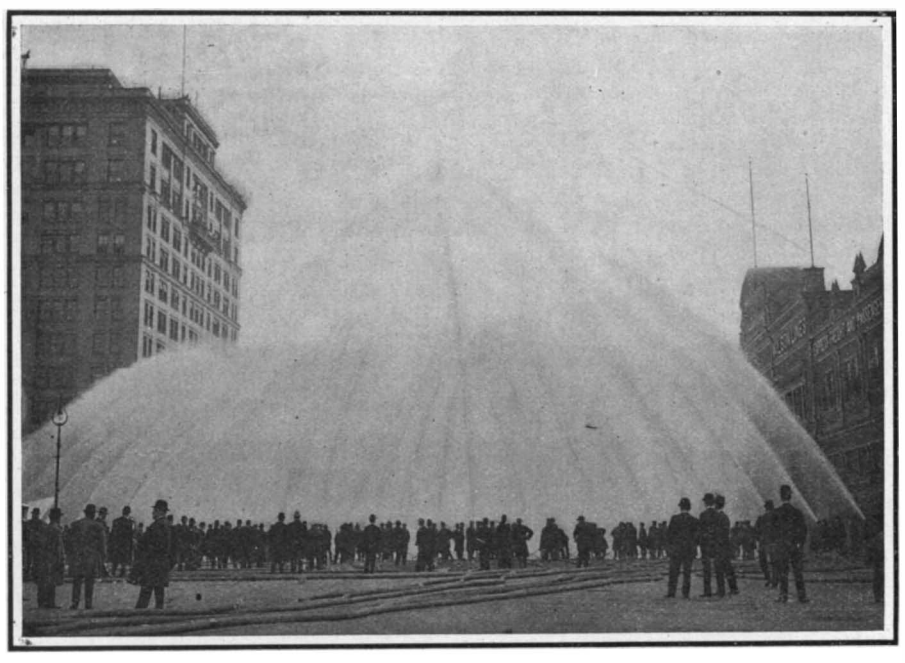
This high-pressure system includes some 63 miles of extra heavy and large mains supplied normally with fresh water, on which at a moment's notice by starting the pumps at two stations located at South and Oliver Streets on the East River, and at West and Gansevoort Streets on the North River, pressures up to 300 pounds to the square inch are available throughout the protected district, which at present is bounded by Chambers Street, the North River, 23d Street, Second Avenue and East Broadway. It is in the actual use of the new system in fire fighting that interest to-day centers, as the high-pressure system promises to become general in the larger cities of the United States, ultimately displacing entirely the portable steam fire engine. There are still, however, unsolved problems in its use by the firemen, and for this reason every test either at an actual fire or in a public demonstration or drill, such as the illustrations show, is most valuable. For the high-pressure service means the substitution of large volumes of water at high pressures concentrated at any desired point in the district, for the limited amounts at low pressures furnished by the old distribution systems and the steam fire engines, and this necessarily involves many changes in existing practice. As rapidly as possible all the fire-engine companies in the high-pressure district are being supplied with heavy 3-inch hose, and there are already three fire companies where the fire engines have been removed and high-pressure hose companies specially organized, each equipped with two hose wagons carrying high-pressure hose. In two of these companies have been installed the new special wagons, three of which are now owned by the fire department, while there are also used the large standard hose wagons employed with the engines, whose excellent design and construction make them available for the high-pressure service. The new special wagons, which are unusually wide, are built to carry forty lengths of 3-inch hose, each 50 feet in length, and are drawn by three horses. They weigh empty about three tons and with hose, equipment, and crew, consisting of an officer, engineer, and eight men, about six tons as compared with about five tons, the weight of the displaced steam fire engine. These hose companies answer alarms just as did the fire engines, and in addition to carrying the hose and such accessories as nozzle holders, pressure gages, siamese connections, and other appliances, there is mounted on a platform behind the driver's seat a turret nozzle similar to that employed on a fireboat, to which one or more lines can be connected and which can be manipulated by one man. When one of these hose wagons reaches the fire, lines of hose are stretched from the nearest hydrant, which will not be over 400 feet distant from any building in the protected district, and the engineer is stationed at the hydrant to turn on or off the valves for any of the lines connected at the four outlets, each line being numbered and tagged both at the hydrant and at the nozzle in order to avoid any confusion of orders. Thus the engineer of the steam fire engine, instead of being eliminated, has a less strenuous but equally important function, which will increase in importance when a suitable valve is devised to reduce and regulate the pressure at the hydrant. The pumps at the central station are started at the direction of the fire chief by direct telephonic communication through a special line from a signal box near the hydrant, and

(*Continued on page 335.*)



Typical distribution of high-pressure mains and hydrants. Eight hydrants, to each of which four lines of 3-inch hose are attached, can supply over 23,000 gallons per minute concentrated at any point in the protected district.

High-pressure streams from water tower and nozzles mounted on holders can be thrown easily above a twelve-story building.



Twenty-six high-pressure streams discharging a volume of water sufficient to extinguish any single fire.

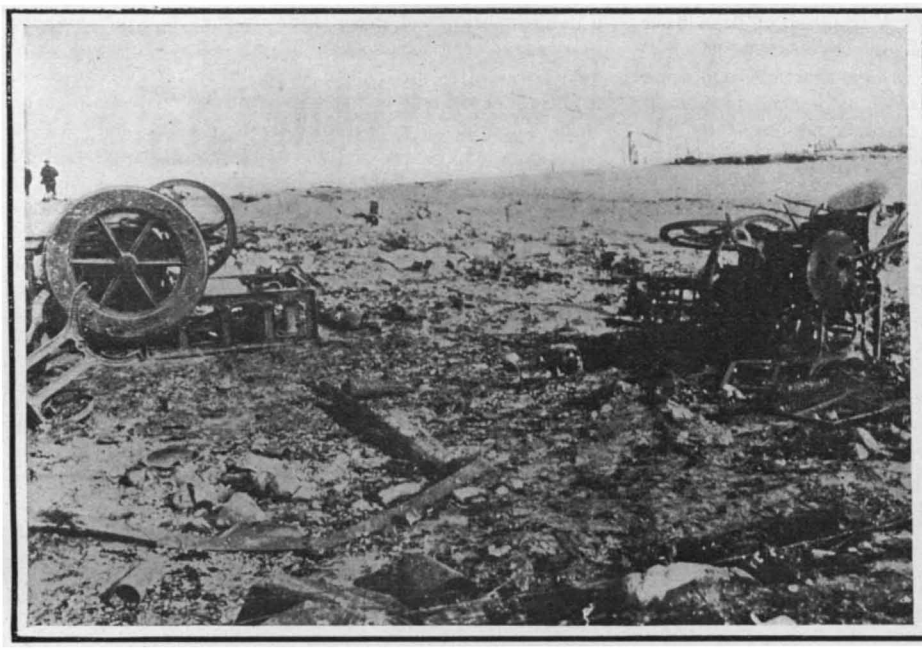
THE MENACE OF THE FOREST FIRE.

BY DAY ALLEN WILLEY.

The destruction of forests in the United States by the fires which occurred during the year 1908 has been the greatest in money value of any yet on record. While the total loss cannot be exactly estimated, the investigation which is now being made by the United States Forest Service bears out this assertion.

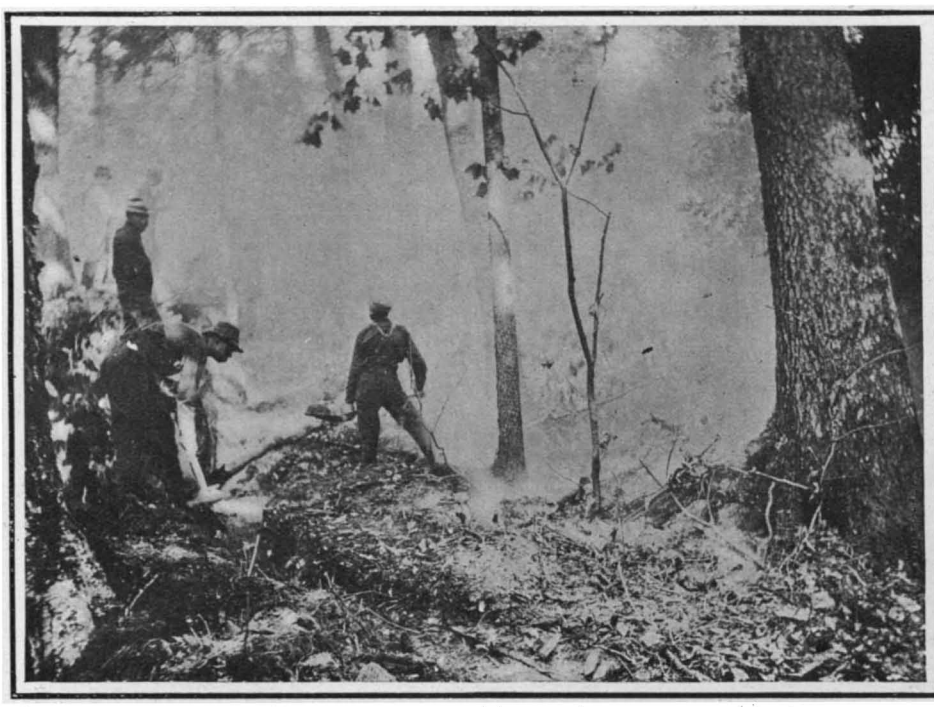
igan, the Adirondack region of New York, and in eastern Maine. As yet the entire extent of the woodland destroyed cannot be given, as the measurements have not been completed.

In some years the loss has averaged at fifty million dollars, representing the value of the timber, the buildings, and other property in the burned area. The past year, however, was one of extraordinary losses. lying between Lake Superior and Lake Michigan and bordering on Wisconsin. This area comprises about 35,000 square miles, excluding the water surface. Needless to say, this region has been the scene of very great activity in lumbering, by reason of the enormous extent of the pine forests. The tracts of first-growth pine are still very large, not only in Minnesota, but in northern Michigan, while nearly all of the region is

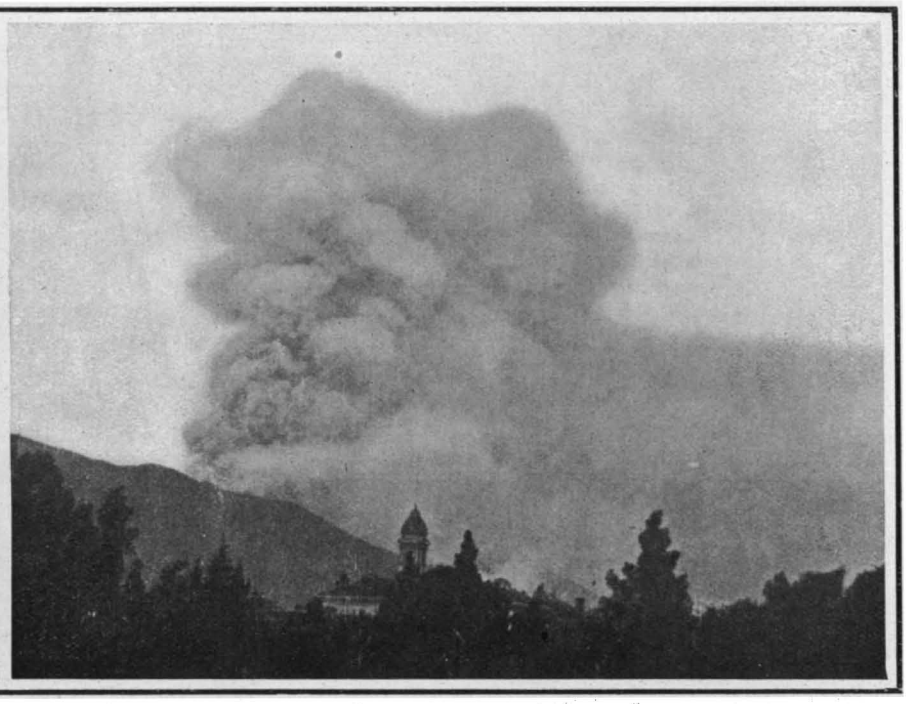


The destruction wrought by forest fire in a western village—only the machinery of a factory left.

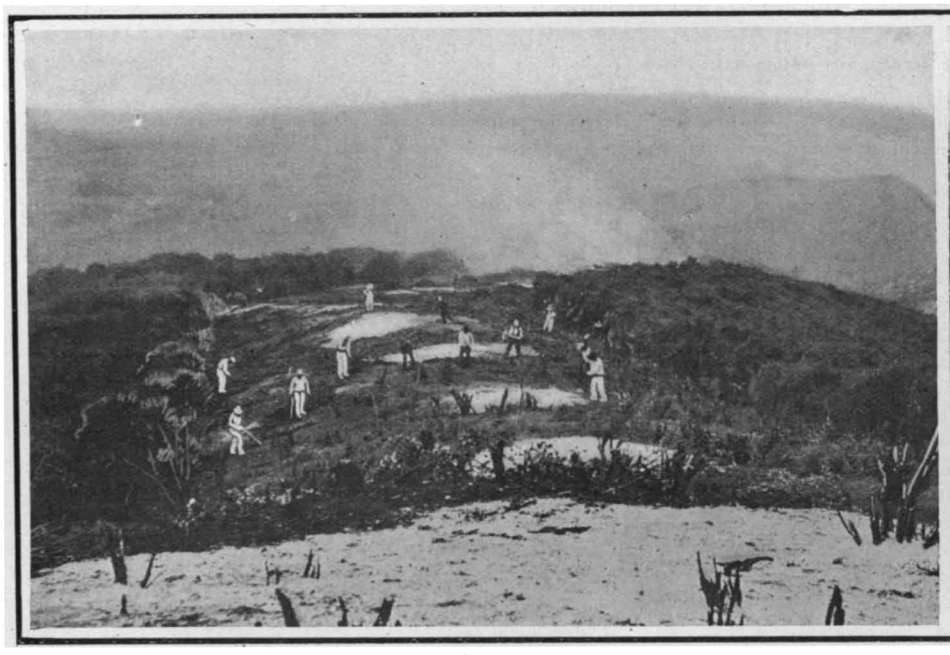
One cause of the forest fire—waste lumber and sawdust carelessly ignited and left to burn. The wind is carrying the fire directly into the standing timber.



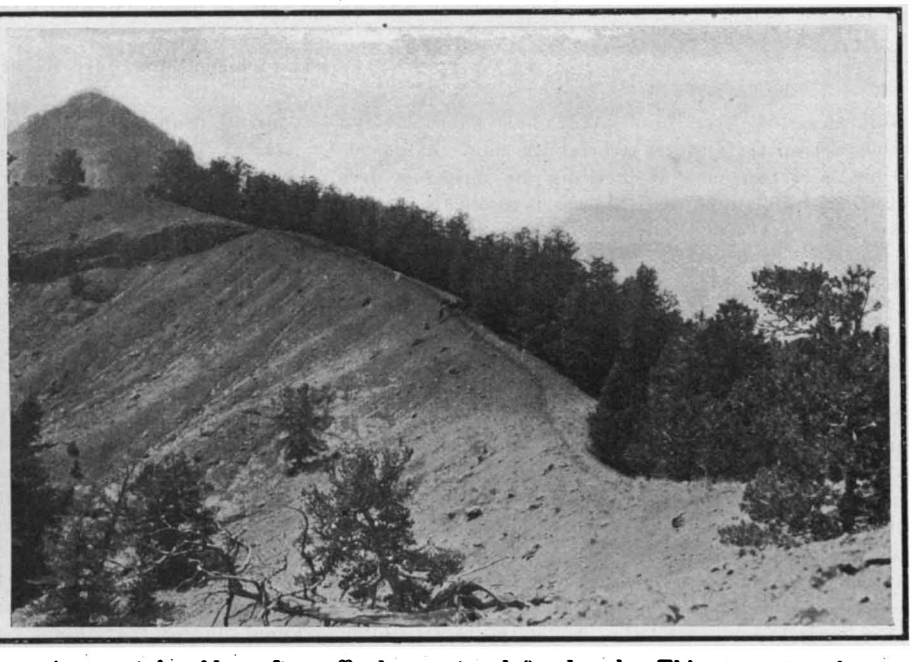
How the rangers fight forest fires by digging trenches and covering the fire with earth.



The rapidity with which a forest fire spreads. Views of a conflagration in Southern California.



Men making a clearing in the timber on a mountain to check the spread of a fire.



A mountain ridge often affords a natural fire break. This one stopped a fire in Wyoming.

THE MENACE OF THE FOREST FIRE.

So much has been printed in the daily press regarding the fires, that the reader might imagine they were extensive wherever large tracts of woodland are to be found. As a matter of fact, the destruction was confined to a comparatively few States, and in some cases to only small sections of these. Yet according to the government experts, the damage caused amounted to fully $100,000,000. These figures are based upon investigations that have been made in the principal centers of disaster, such as northern Minnesota and Michigan, the Adirondack region of New York, and in eastern Maine. As yet the entire extent of the woodland destroyed cannot be given, as the measurements have not been completed.

In some years the loss has averaged at fifty million dollars, representing the value of the timber, the buildings, and other property in the burned area. The past year, however, was one of extraordinary losses. One reason for the extent of the loss was the high grade of the woodland burned, while another was the number of communities which were almost obliterated by the fire, to say nothing of the fatalities, which probably aggregate 500 if not more. Probably the section of the country which suffered most disaster was that portion of Minnesota near the head of Lake Superior, several counties in northern Wisconsin on the border of the same lake, the northern section of the Michigan peninsula, and the portion of the State lying between Lake Superior and Lake Michigan and bordering on Wisconsin. This area comprises about 35,000 square miles, excluding the water surface. Needless to say, this region has been the scene of very great activity in lumbering, by reason of the enormous extent of the pine forests. The tracts of first-growth pine are still very large, not only in Minnesota, but in northern Michigan, while nearly all of the region is heavily wooded with younger trees of second and third growth.

The forest fires of 1908 caused the destruction of several important towns. The largest community in the series was Chisholm, fifty miles west of Duluth. This place had a population ranging between 4,000 and 5,000 people. Its principal buildings were constructed substantially of fire-resisting material. The streets were broad, and the edge of the town was somewhat removed from the woodland in the vicinity. Such was

the magnitude of the fire, however, that it destroyed nearly every building in Chisholm, leaving merely a few brick walls. Here the loss ran into several million dollars. Next to the destruction of Chisholm, the burning of several small settlements on the Michigan peninsula was the most notable instance of the danger of forest fires to communities. The principal community destroyed was Metz, a settlement of about 500 people located in Presque Isle County in the northeastern part of the State on the Detroit and Mackinac Railroad. Metz is one of a half dozen communities inhabited principally by workers in the timber tracts. In the vicinity the cleared lands are occupied largely by small farmers. The fire that swept over Metz burned most of these farmhouses, and killed all living vegetation in the fields. Posen, six miles from Metz, was saved only by the efforts of the people aided by the railroad employees. Alpena County, adjoining Presque Isle on the south, was also visited by fire at the time Metz was destroyed. The flames extended to the suburbs of Alpena, the principal city of the Michigan peninsula, and only after a contest of three days and nights did the citizens, aided by the fire department, succeed in preventing another great disaster.

The Adirondack forest region has been the source of so many fires, and has been so carefully studied, that the State of New York's loss has been closely estimated. In a single year recently, fires started in areas representing 3,500,000 acres of its woodland. The trees on no less than 500,000 acres were ruined for commercial purposes. The expense of fire protection and fire fighting during the year in question amounted to $185,000. In the ten years ending with 1907 the forests destroyed in these mountains have covered 700,000 acres, while the State records show that $500,000 has been expended in checking the spread of fires and in extinguishing them where possible.

These figures are of unusual interest at this time, because they show the immense loss which can be caused in comparatively a limited area, contrasting the Adirondack region with the woodlands of such States as Washington, Idaho, Oregon, or the three Western States which were so devastated during 1908. Where the cause of Adirondack fires was discovered, it was shown that nearly all of them were due to inexcusable carelessness or negligence. In one year, out of 300 fires in this region, 121 were traced to sparks from locomotives, 88 to piles of leaves left burning, 29 to camp fires made by hunters and others, and 6 to embers from tobacco pipes and cigars. This shows that the great majority of the fires could have been avoided. Timber experts are of the opinion that sparks from locomotives form one of the most prolific sources of forest fires. A study of the fires made in twenty-eight different States, shows that in one year the sum of three million dollars in timber was destroyed by flames originating from this cause. Spark arresters ought to be more generally employed.

As already stated, the burned area of timber land in 1908 was confined to a few sections of the country. In one year recently, timber covering tracts of 7,800,000 acres was ruined by fire. The wood was distributed over no less than twenty-eight different States, the total loss being estimated at twenty-four million dollars. The fire loss of 1908 is divided among only five States. It is noteworthy that the fires in the great timber regions of such States as Colorado, Montana, Oregon, Washington, Idaho, and Wyoming have been very small in extent in comparison with the sections of the country we have named. One reason for this is that so many of the national forests are located in the States named, and so much of the woodland is under the system of our national forest protection. It should be remembered that nearly all American fir and cedar come from the States of Washington and Oregon. In the West many of the most valuable growths of hardwoods are still standing. A number of fires have started from various causes on the forest reservations—usually through the carelessness of explorers, prospectors, and others—but they have been prevented from spreading and doing material damage by the officers of the Forest Service, who are distributed throughout the territory under the control of the government.

The forest fire is not the only menace. If underbrush or dry weeds and grass ignite, the flames spread with surprising rapidity. The heat generated often creates a strong air current, which hastens the progress of the fire. Since many dwellings and towns are adjacent to fields of this sort, especially in a country of "clearings," they are often threatened by such dangers. These "ground fires" are too well known to dwellers on the western prairie, even where there are no young trees or bushes. If the moisture has evaporated sufficiently, the crust may become as inflammable as dry peat, since it is so matted with roots and other dried vegetation that a piece of it can literally be ignited with a match. When a prairie fire gets under a good headway, it is very difficult to control if any breeze is blowing. Fires of this sort have swept over parts of Kansas, Nebraska, and other States in the plains country, reducing entire villages to ashes.

The fire most dreaded by the timberman and farmer in the woodland clearing is the "top fire." In a pinery, for example, a dry twig or cone may ignite from the flying sparks of a sawmill stack. If any breeze is blowing the blaze will spread through the tree tops. The fire is mostly in the air. It leaps from tree to tree, sending a shower of sparks and cinders upward and downward. The bulk of the flame is at such an elevation that nothing can be done to extinguish it except to cut a lane in the forest to prevent the spread of the fire—if there is still time. Such a fire is hard to fight and very destructive. The tops of the trees are burned, and the lower portions die in consequence.

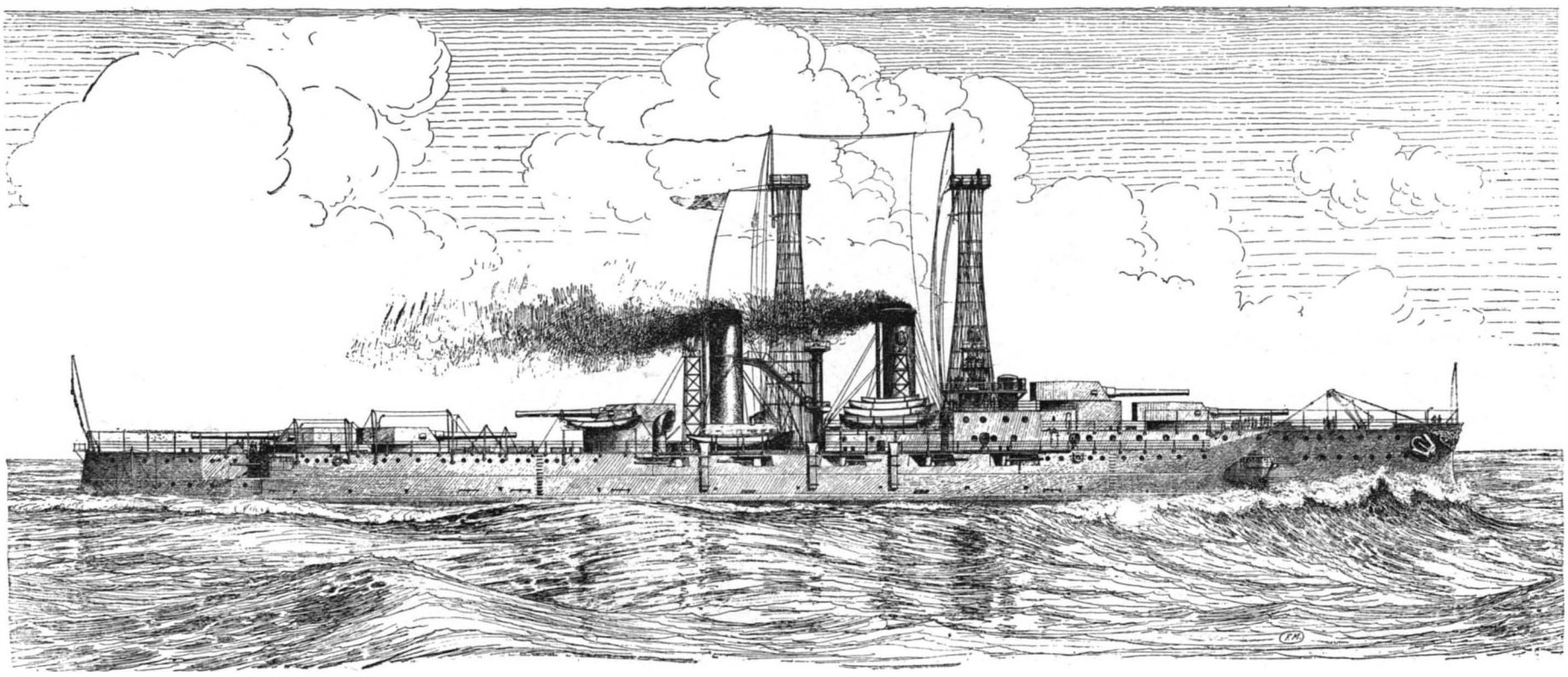
Had the people of the forest States a comprehensive knowledge of the simple yet effective means that can be employed in obstructing and deadening fires, undoubtedly the annual losses would be reduced to a small percentage of the present figures. One reason why forest and field fires often get beyond control, is because efforts are made to beat them out with green brushwood or by covering the ground flame with piles of green leaves, if these can be procured. The burning area may be so large that the fire gets away from such control, and the workers must give it up. Had they found an open space or forest lane, and here turned up the damp earth in front of the advancing fire line, they could thus check its progress, and the labor of extinguishing it would be lessened.

During the dangerous seasons patrols should be actively looking out for fires, and if possible provision should be made to enable them to summon assistance readily in case of need. This may be done by telephone lines or by signal towers. A good plan would be to have located at various places simple tools, for often a single man, properly equipped and ready, can put out an incipient fire.

The tools for killing a fire are various, a great deal depending upon the topography of the country. Only a densely branched green pine or spruce brush may be necessary, or a large-sized broom with which to whip out the running fire, or to sweep burning embers back. A spade or shovel is needed to cover burning logs or embers with soil or to dig trenches. A mattock is necessary where the soil cover is tough and the soil rooty, and hence not easily handled with a spade or shovel alone. Other useful aids are an ax to get logs out of the way of the trenches, or a saw for the same purpose, pails to carry water for drinking purposes and, if practicable, for quenching smoldering embers, and pack baskets to carry provisions.

THE LAUNCH OF OUR FIRST "DREADNOUGHT."

The launch of the "North Dakota," the first battleship of the "Dreadnought" type to be built for the United States navy, which took place on November 10 at the Fore River yard, Quincy, Mass., is an event of more than ordinary naval importance. Although we seem to have lagged somewhat behind the foreign navies in building ships of this type, the British having seven or eight afloat, the Germans two or three, and the Japanese two, it must be remembered that in the "South Carolina" and "Michigan" we possess two ships afloat which, though they are of only 16,000 tons displacement, each mount eight 12-inch guns, and therefore, strictly speaking, belong to the "Dreadnought" type. The launch is also significant because of the rapid work which has been done upon this, considerably the largest vessel ever built for our navy, its keel having been laid as late as December 16, 1907, and the ship at the time of the launch being nearly sixty per cent completed.



THE 20,000-TON, 21-KNOT "NORTH DAKOTA."—OUR FIRST "DREADNOUGHT."

Launched at the Fore River yard, November 10, 1908.

The remarkable record made by the shipbuilders in launching the "North Dakota" in 10¾ months from the laying of the keel is noteworthy, when it is considered that although in one or two instances abroad a battleship has been launched in slightly over eight months from the laying of the keel, still in these cases the per cent of completion of the foreign ships was not so great as in the case of the "North Dakota," where 9,000 tons of material, or sixty per cent of the ship, have been worked in in the record time above mentioned, and in addition, much of the vessel's auxiliary machinery, fittings, and equipment are already finished and ready for installation, including the five huge turrets in which will be installed the main battery of the vessel. These turrets are at present completed and lying on the dock alongside of the berth to be occupied by the "North Dakota" when she takes her initial dip, and the installation of these housings will be at once proceeded with. It is rightly considered, therefore, that the Fore River Company have made a world record in the construction of the "North Dakota" to date; and should the same rate of produc

tion be maintained for the forty per cent yet to produce before the vessel is ready for trial, it will result in all records for battleship building being at least equaled if not surpassed.

The accompanying line drawing, which has been reproduced from the working plans of the ship, gives an excellent impression of her general appearance when viewed from abeam, and also reveals for the first time many interesting particulars of her construction. The most striking feature is the two lofty steel lattice masts, each built up of hollow steel tubing running in reverse spirals from deck to top platform. This platform will be occupied by the officers who will have charge of fire control; and it will be their duty to record the fall of the shots, determine the range, and telephone the results down to the officers in the various gun turrets. Note should also be made of the three openwork towers, each surmounted by a large searchlight. Compared with previous battleships, there is a distinct absence of top hamper in the way of lofty flying bridges, boat cranes, and superstructures. The turrets are all arranged on the longitudinal center line of the ship, consequently the whole strength of the battery can be concentrated on either broadside. The secondary battery of fourteen 5-inch guns is mounted on the gun deck. Probably in future ships these guns will be mounted one deck higher, in order to lift them clear of spray and broken water. The "North Dakota" will displace 20,000 tons on her normal draft of 26 feet 11 inches. She will be driven by Curtis turbine engines of 25,000 horse-power at a speed of 21 knots. Her coal supply when the bunkers are completely filled will be 2,500 tons.

SUCCESSFUL TEST OF NEW YORK'S HIGH-PRESSURE FIRE SERVICE.

(*Concluded from page 332.*)

the valves at the pumps are adjusted to 100 pounds pressure at the outset, and until otherwise ordered this pressure is maintained at the pumps. It must be remembered, however, that with pressures in excess of 50 pounds at the nozzle it is impossible for firemen unaided to direct the stream or even to hold the nozzle, which must be made fast in some way or a turret nozzle or water tower must be employed. It is just this that at present limits the efficiency of the high pressure, as often a fireman may gain a difficult but advantageous position where a small stream properly directed will do great execution. The nozzle holders now used by the New York fire department have iron spider legs with prongs, which when fastened in the asphalt, or wood, or between granite blocks furnish a firm support for the nozzle, which can be directed by two or three firemen. While there is always available a sufficient volume of water to drown out any fire, yet it must be remembered that damage by water is just as serious as damage by fire, so that it will take some little time for the firemen to learn how to use the high pressure judiciously; but against any large fire where a large volume of water is needed, or in the case of an incipient conflagration, the usefulness of the high-pressure service is not open to the slightest question. For from eight hydrants with but six of the ten pumps at the two stations in operation can be discharged some 23,000 gallons per minute at a station pressure of 270 pounds, or at the rate of 33,000,000 gallons in 24 hours. There could be concentrated at such a point as the corner of West and 12th Streets a greater volume of water and at a greater pressure than could be supplied by practically all the available engines on Manhattan Island. From eight hydrants could be taken thirty-two lines of hose, affording water to twenty-six nozzles either 2 inches or 1¾ inches in diameter, six of the 2-inch nozzles being supplied by siamesed connection from two lines of hose. Or the same eight hydrants might be used to supply both the high nozzle and the deck pipe of a water tower, and the turret nozzles of four hose wagons, in addition to ten 2-inch nozzle streams siamesed from twenty lines. Streams thus furnished can be sent without difficulty to the top of a twelve-story building, but for a building of this height or even higher the method to be followed, where possible, would be to fight the fire from the inside, connecting the high pressure to the standpipes of the building, and those of neighboring structures if necessary, as each high building is required to have such standpipes and an adequate supply of hose on each floor, through which powerful streams of water could be delivered even on the highest stories.

In its ability to deal effectively with any possible fire in a large high building and to prevent absolutely any large fire becoming a general conflagration or extending beyond its point of origin in a district where the number of fireproof buildings is all too small, the New York high-pressure service as now in operation marks a distinct epoch for a fire department even as efficient and well equipped as that of New York city, while as a piece of well designed and executed municipal engineering the entire installation has received unstinted praise.

Correspondence.

THE WALSCHAERT VALVE GEAR.

To the Editor of the SCIENTIFIC AMERICAN:

In your paper dated October 31, 1908, I note what you say in regard to the Walschaert gear in your engineering column on page 295. You speak of its being adopted recently. If you mean that it has been adopted in America inside of ten years, I wish to call your attention to an interesting fact.

Mr. William Mason, builder of locomotives and cotton machinery in Taunton, Mass., built in the early sixties an engine called the "William Mason" for the Boston, Clinton & Fitchburg Railroad. This engine was a six-wheeled bogie, and was equipped with Walschaert gear or valve motion as it is sometimes called. Unless I am mistaken, two or three other locomotives were built, equipped with the same valve motion, for some other railroads. I have a picture of this locomotive at home, and the next time I return, I shall be glad to send it to you if you desire. One interesting thing may be noted, however, that Mr. Mason was laughed at and ridiculed when he built this locomotive. But the railroad officials said that there was not her like for pulling. Mr. Mason was a man who knew how to build locomotives; for proof ask any engineer who has run one of his locomotives. If he were alive to-day he could and would probably laugh at the builders who build these enormous locomotives, as much as they did when he equipped his locomotives with the Walschaert valve gear. CHARLES E. FISHER.

Hanover, N. H., November 1, 1908.

SOLID VS. PNEUMATIC TIRES.

To the Editor of the SCIENTIFIC AMERICAN:

Having noticed an article in your issue of August 29, on comparative tests made between solid and pneumatic tires, I am prompted to give a little of my experience as the patentee of twenty-two different types of both solid and pneumatic tires and as the promulgator of crosswire tires which now are well known in all countries on the globe and which tires constitute no less than 90 per cent of all solid tires used on motor-driven vehicles.

Before commenting upon the report on tests made, I wish to say that we will admit generally that there is no tire as easy riding and will cause less vibration on a motor-driven vehicle than a pneumatic tire, provided the same is not too highly inflated.

In reporting tests, however, between solid and pneumatic tires, it is the plain and honest duty of the reporter to state at what pressure the pneumatic tire was inflated when the test was made, as well as the solidity to which the solid tire was cured and the shape thereof. Solid tires can be cured to such a carrying capacity that one cubic inch will carry 500 pounds without yielding ¼ inch, while it can be also cured so that a cubic inch of rubber will only carry 5 pounds to yield the same distance, and without the reporter giving the consistency or carrying capacity to which the solid tire was cured, the report is of no account and cannot be used to enlighten the inexperienced.

The writer's experience has proven that a solid tire not properly formed, that is cured so hard that it will, on a rough pavement, bounce from one cobblestone to the other and will not keep down to the roadbed, is very little better than a steel tire; but on the other hand when the tire is molded in such a manner so that there will be one portion of it always compressed, so that when the wheel strikes an obstacle in the road (which has a tendency to raise the wheel off from the roadbed), this portion of rubber will pop down and keep in contact with the roadbed and prevent the wheel, which would be off the ground, from acquiring a very high speed while the car almost comes to a stand-still, thus losing power and grinding off rubber unnecessarily when the wheel again comes down to the earth, will show entirely different results.

We insist that solid tires must be kept down to the pavement in order to ride comfortably and in order that you can acquire a high speed. It is no difficult task whatever to acquire a speed of from 25 to 45 miles an hour on solid tires, provided there is a bead on the tread of the tire which will, with a normal load, be compressed to the extent of ½ inch, so that when you strike an object that has a tendency to raise the wheel ½ inch, this bead can relieve itself and assume its normal shape and reach down and keep the wheel in contact with the road.

The writer had at one time designed tires that were placed on high-speed cars capable of running 50 miles per hour. The tires were smooth treads and cured rather hard. They were cured with a view of acquiring carrying capacity rather than comfortable or fast riding and it was impossible to make more than from 18 to 19 miles per hour on reasonably good pavements, as the tire was off the pavement nearly half the time, and when it would come down the tire had acquired such a speed that when the wheel struck the pavement it was as though an emery wheel would come in contact with a piece of chalk—the roadbed would grind the face of the tire down so that there soon would be nothing left on the rim.

Finding this unsatisfactory, we removed the tires and placed upon the same wheels tires with a center bead measuring about ½ inch high. This bead was compressed completely out of sight as the car stood on the pavement.

While running the car, we found it a very easy matter to acquire a speed of 40 miles per hour over the same pavement on which it was impossible to get a speed of 20 miles per hour with the hard, smooth-face tire, and we would acquire this 40-mile speed with less fuel than was used with the hard tires when we were scarcely making 19 miles per hour.

After having made this experiment, and found that the speed to be acquired on solid tires depends upon the tires being softly cured and provided with a bead that would quickly adapt itself to the unevenness of the roadbed, we have decided that the art of successfully making use of solid tires will depend greatly upon the judgment exercised in shaping and curing the rubber and the proper application of the same to such loads as they are adapted to. All solid tires should be loaded, in order to acquire a rapid speed (without too much vibration) to nearly their full carrying capacity, with good buoyant springs between the axle and body of the car. Tires for electric cars used on pavements generally should have narrow treads.

My experience has also led me to believe that while pneumatic tires generally prevent vibration, they can be inflated so highly and solid tires can be cured so softly and built so high above rim that when the two are passing over the same obstacle side by side at the same speed, the pneumatic tire will rise 50 per cent higher in passing over the obstacle than the solid tire will, and consequently cause more vibration.

J. A. SWINEHART.

Akron, Ohio.

The Current Supplement.

The current SUPPLEMENT, No. 1715, opens with a brief illustrated article by Frederic Blount Warren on the recently completed Walnut Lane bridge at Philadelphia, which is the largest concrete bridge in the world. The effect of motors on macadam roads is ably set forth by L. W. Page, director of the Office of Public Roads. What the electric furnace is doing in Germany is explained in a simple convincing way that reduces the whole matter to dollars and cents. At the Franco-British Exposition held this year, the display of modern ordnance attracted a large share of public attention. The most complete display in this department was that of Vickers, Sons & Maxim, which display, in addition to several models of battleships and armored cruisers, included a very complete exhibition of rapid-fire guns, ranging from the heavy 7.5-inch piece down to the little rifle-caliber automatic, capable of delivering 500 shots a minute. In all, 22 illustrations of these wonderful weapons are published in the current SUPPLEMENT, together with a brief article in which their purpose is explained. The military use of the airship and aeroplane is capably discussed by Major Goebel of the German army. Mr. E. J. Munby contributes an article on "Further Improvements in Coal Washing Jigs," in which he amplifies Mr. Driescher's information. Sir Hiram Maxim has been busily engaged in exposing the fallacy of systems for breaking the bank at Monte Carlo. His convincing scientific arguments against such folly are presented. The usual Trade, Electrical, and Engineering Notes will be found in their accustomed places.

Official Meteorological Summary, New York, N. Y. October, 1908.

Atmospheric pressure: Highest, 30.58; lowest, 29.56; mean, 30.13. Temperature: Highest, 84; date, 17th; lowest, 38; date, 31st; mean of warmest day, 73; date, 17th; coolest day, 42; date, 31st; mean of maximum for the month, 66.3; mean of minimum, 52.9; absolute mean, 59.6; normal, 55.5; excess compared with mean of 38 years, + 4.1. Warmest mean temperature of October, 61, in 1900. Coldest mean, 50, in 1876. Absolute max. and min. for this month for 38 years, 88 and 31. Average daily excess since January 1, + 1.7. Precipitation: 1.92; greatest in 24 hours, 0.86; date, 25th and 26th; average of this month for 38 years, 3.65. Deficiency, —1.73. Accumulated deficiency since January 1, —0.21. Greatest precipitation in October, 11.55, in 1903; least, 0.58, in 1879. Wind: Prevailing direction, northeast; total movement 8,470 miles; average hourly velocity, 11.4 miles; max. velocity, 50 miles per hour. Weather: Clear days, 14; partly cloudy, 6; cloudy, 11; on which 0.01 inch or more of precipitation occurred, 9. Frost: Light, 13th and 14th.

Volcanic Ash as a Building Material.

Consul George H. Scidmore, of Nagasaki, forwards a pamphlet, printed in English, issued by a Japanese company, which describes the use and importance of volcanic ash in combination with Portland cement, especially for construction work in salt water. The advantages claimed for this volcanic ash are that in combination with Portland cement it gives a greater tensile strength than cement mortar alone. It is also claimed that the mortar is denser than cement mortar and does not permit the percolation of water, thus obviating the injurious action of sea-water salts. This density gives it a superior quality for construction of water reservoirs and reinforced concrete for the protection of iron from oxidation. The consul adds that should the correctness of the Japanese company's claims be proved by trial, it is highly probable that the enormous volcanic resources of the Philippines will provide for a new and profitable industry.

Bleaching Soda.—I. 5,000 parts of soda-water glass are heated and thoroughly mixed with 2,000 parts of calcined soda. The resultant hard mass is reduced in a stamping mill. II. Mix 2,500 parts of soda-water glass, 3,500 parts of calcined soda, 300 parts of pulverized borax, 400 parts of powdered soap, 300 parts of potato starch. III. Mix 8,000 parts of pulverized soda crystals and 2,000 parts of powdered water-glass.

A MULTIPLE CYCLE FOR THE BLIND.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

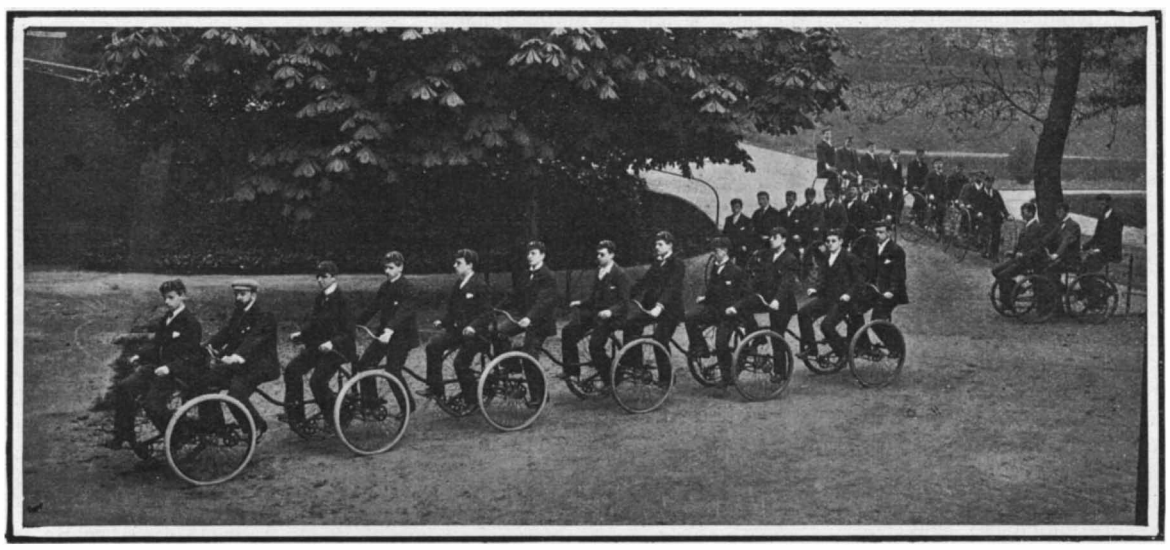
The possibility of cycling becoming a pastime in which the sightless would be able to participate would appear impossible, but a visit to the Royal Normal College and Academy of Music for the Blind at Upper Norwood, London, would serve to dispel this illusion. Among the various recreations provided for the blind pupils at this institution none is so popular as cycling. In order to enable the scholars to indulge in this sport numerous machines have been acquired, but owing to the peculiar conditions prevailing they are necessarily of special design. The most popular of these machines is the multicycle shown in the accompanying illustration, which, as will be seen, is devised to carry a team of twelve cyclists.

This cycle, which was designed and constructed by one of the foremost cycle manufacturing firms of the United Kingdom, is built up of six two-wheeled members, each adapted for two persons, coupled together, there being a connecting bar between each successive pair of wheels to form the complete train. The machine, which is of substantial build and devised to carry riders of either sex, has a total length of 28 feet.

Each pair of wheels is a complete unit in itself, including differential gearing in the single axle, and seats for two riders, one being in front of the handle bars, which are of the usual design for the rearmost of each pair of riders, while the front seat has side handles such as was the practice in the old tandem tricycles. The frame is of special design, the front seats being carried on vertical supports, as is also the handle-bar pillar connecting with the axle, while the rear seat is supported upon the raised hump of the bar connecting succeeding pairs of wheels together, except in the case of the extreme rear rider, where the seat is also carried on a vertical pillar from the main framing of the machine. The connecting bar itself is swiveled and the machines are coupled up by this moving joint with sliding pins, the connection in front being made with the steering handle-bar column of the preceding machine and at the opposite end to the main frame of the axle to the succeeding unit. By this arrangement perfect lateral play is provided such as is required in negotiating curves; while the system also enables the train to be split up into sections, such as a quadruplet, sextette, octette, or train for ten riders.

Of course the machine has to be guided and controlled by a sighted person, who in this instance occupies the second seat, which gives command of the first pair of handle bars. The slightest deviation to either side of the front wheels is transmitted through the coupling bar to the second pair of wheels, the driver of which can act in concert, thereby conveying the same intimation to the third unit, and so on to the end. The drive is of the ordinary rotary type geared to 51 and each rider participates in the propelling action. Even the sharpest curves can be rounded with facility and ease. Each handle-bar is equipped with a powerful brake and the machine can be pulled up dead within a short distance when the whole of the braking facilities are simultaneously applied, rendering it perfectly safe.

The pupils do not by any means confine their participation in this recreation to trips around the extensive grounds surrounding the institution, but under the guidance of a competent sighted captain are frequently to be seen upon the high roads of the neighborhood. From time to time long excursions are undertaken into the country, the longest journey in this direction being a round journey to Brighton on the south coast, a total distance of 100 miles. For this journey a special crew was selected from sixty candidates and the trip was accomplished in 10¾ hours' actual running time, an average speed of 9.75 miles per hour.



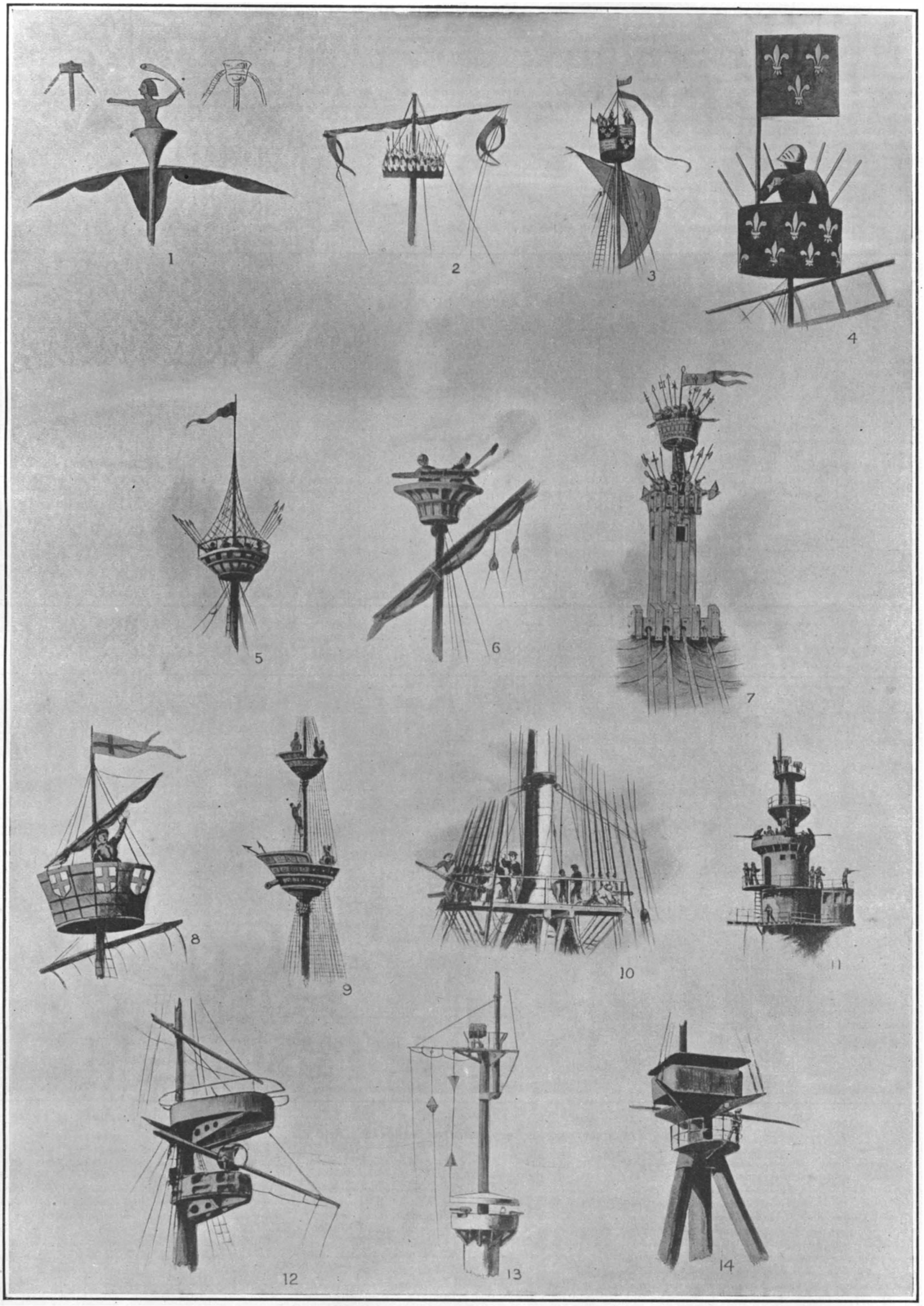
A MULTICYCLE FOR THE BLIND.

ACTION ALOFT; OR FIGHTING TOPS, PAST AND PASSING.

The use of the fighting top may be traced back through the Dark Ages right into the depths of antiquity. That the warships of ancient Egypt were equipped with fighting tops in which stood slingers ready to sweep the decks of an adversary, we know from wall paintings discovered at Thebes; and among the ruins of Khorassan and Nimrud have been found other representations of the top showing that its use was not confined to the land of the Pharaohs. Its shape was frequently that of a drinking cup (*carachesium*). In the war galleys of the Greeks, Romans, and Carthaginians the use of the fighting top was far from universal, possibly because of the ramming tactics then usual. At the high speed at which these long, narrow vessels were propelled, a collision would have jerked masts and tops overboard; indeed, their masts were often made to lower, and sometimes were even landed before an engagement. Fighting tops were frequently rigged up on board mercantile vessels, which were slower and broader craft, with the object of assisting in their defense against pirates. In the warship proper their place was taken by lofty towers substantially constructed of iron and timber, although, according to a French work on navigation, platforms for archers, stone throwers, and slingers were occasionally hoisted half-way up the masts of a war galley.

We do not hear much of the fighting top in the "long ships" of the Danes, Saxons, and Vikings, which were (like the ancient war galleys) narrow, oar-propelled vessels, but as in the progress of naval evolution they approached more nearly to the "round ship," or short, broad-beamed sailing vessel of the Middle Ages, the top reappeared. The first "round ships" were merchantmen, and, as in classical times, these were converted into fighting vessels by the addition of "top-castles." Fore and after "castles" were also built upon them by a special class of skilled workmen. These converted merchantmen formed the fighting fleets of the thirteenth and fourteenth centuries. In the battle with Eustace the Monk in the Straits of Dover in 1217 the English threw down sacks of unslaked lime which, as they had been careful to keep to windward, smothered and blinded the Frenchmen and contributed not a little to their defeat. The top-castles of this period were of various forms—some square and embattled, some round, some built round the mast, others fastened either before or abaft it. We see by the illustrations in medieval manuscripts that the tops were frequently elaborately carved or decorated in brilliant colors and gilding. But on the other hand many were merely rough basket-work affairs, or in some cases merely barrels like the crow's nest in a modern whaler. At the famous battle of Sluys in 1340 the French ships hoisted small boats filled with stones up to the tops, so that the men stationed aloft should not run short of ammunition. Ten years later, when King Edward III defeated the Spaniards at the battle known as "Espagnols sur Mer," Froissart relates that the king ordered his ship to be run aboard the first of the enemy they came up with. This was a huge ship towering high above the Englishman, and the crash as they met was so violent that "from the concussion the top on the mast of King Edward's ship came in contact with that of the enemy and carried away his mast, and all who were in the top were drowned."

As time went on the number of masts was increased to two and even three, the ships themselves became bigger, and their tops invariably circular and of much larger circumference than before. In some cases—probably in the Mediterranean only—a tower was built round the mast to within a short distance of the top, so that fire could be maintained from two patforms, one above the other. This revival of the Greek and Roman "turres" or "towers" is said to have been originated as far back as the tenth century by the Emperor Leo of Byzantium, who used them in his "dromons," which were the biggest Mediterranean battleships. Small cannon and "hand-gonnes" began to make their appearance aloft. A Dutch engraving toward the end of the fifteenth century depicts a three-masted carrack, each of whose masts is terminated by a huge round overhanging top. Round the two foremost are ranged the big "viretons" or darts that could be hurled so effectively from a height; but in the mizzen top is a small swivel gun, with a shoulder piece which seems to be pivoted on the mast itself. At this period it was customary to stretch strong netting over the decks and castles of a fighting ship, which sloped steeply down to the bulwarks. This was not only for the discomfiture of an enemy's boarders but to break the fall of the debris and spars from aloft, and to protect the crew from the larger kinds of missiles thrown from his fighting tops, which in their turn were also protected by a bell-shaped netting overhead. In the sixteenth century the tops were bigger and apparently shallower than formerly, and in addition to being decorated with ornamental shields and carving were provided with "top armor." Strange to say, this "armor" had no protective qualities, as it consisted merely of red, white, yellow, and green kersey cloths lined with canvas which were hung round on special occasions, when, as we should say, it was necessary to "dress ship." A multiplicity of tops was for a little time quite the vogue. The "Grande Françoise" of 1527 had no less than five masts. One of these alone carried four tops, one above the other, the last "so high that a man standing in it did not look bigger than a chicken to those below." In a description of the great "Santa Anna" built at Nice for the Knights of Malta in 1530, and armored all over with numerous leaden plates fastened by brass bolts, so that "it was impossible to sink her although all the artillery of a fleet were fired against her," we are told that she had three tops, one above another, topmast above topmast, and constructed not merely for the convenience of setting the sails, but also to mount small pieces of artillery, which she always carried. The round-top such as those carried in Tudor times lasted till well into the eighteenth century, but it became less and less a platform for guns and more and more important with regard to the rigging and navigation of the ship. Thus in Falconer's Dictionary (1771) we find that "the principal intention of the top is to extend the top-mast shrouds, so as to form a greater angle with the mast, and thereby give additional support to the latter." By this time the top had become more square than round, only the forward part being semicircular or having rounded corners. It was entirely open at the sides, but on the after end was provided with a rail about 3 feet high, to which was still hung, at times, the decorative "top-armor," now of red baize or red painted canvas. But it still served as a fighting platform. "In ships of war," says Falconer, "it is used as a kind of redoubt, and is accordingly fortified for attack or defense, being furnished with swivels, musketry, and other firearms, and guarded by a thick fence of corded hammocks." But before very long the use of small cannon and even musketry in the tops fell somewhat into abeyance. Nelson, it is said, would never allow this form of fighting, which, in his opinion, only killed a number of men without affecting the issue of a battle. The top of Nelson's day remained practically the same, at any rate until the total abolition of sail power in battleships toward the end of the last century, the only difference being that the swivel gun was replaced by the machine gun, Nordenfeldt, Gardner, Hotchkiss, or Gatling. The French, who had always paid particular attention to their armament, made the first steps toward the fighting top proper by surrounding the ordinary tops of some of their ships of war with steel breastworks. In the British navy low open fighting tops were carried by the "Inflexible," "Thunderer," "Glatton" and other early turret ships. But the fully rigged broadside battleship still remained faithful to the flat, open variety. France in the meanwhile began to build veritable castles, with top piled on top, on board her warships, so that in some cases their stability was affected and some of them had to be removed. The German navy at one time seemed inclined to abandon the light open top for the French type of fighting mast, but the fashion was but short-lived, and where fitted the tops were removed and replaced by the type which now seems to be the accepted pattern in that navy, and which seems to have a good deal to recommend it. The lower portion is rather like a low tower surmounted by a round top with a roof, but above are only comparatively light masts for signaling purposes and for carrying an electric projector. Of late years the British navy has in its newest battleships and cruisers again abandoned the practice of carrying an armament aloft and their tops are utilized as fire control platforms. It seems not improbable that



1. Three old fighting tops; the first from Nimrud, the second from Khorsabad, and the third from Thebes. 2. Temporary fighting top in an ancient galley. From "La Marine," Paris, 1844. 3. Top of the "Thomas," King Edward III's ship at Sluys. From Froissart, 1340. 4. French top, 1390. From Froissart. 5. Fifteenth century fighting top with overhead netting. 6. Fighting top with cannon. From a fifteenth century woodcut. 7. Fighting top and tower. From Valturius. 8. Foretop H. M. S. "Regent," 1512. 9. Tops on mainmast of H. M. S. "Ark Royal," 1588. 10. Top of a French man-of-war with swivel guns, 1844. From "La Marine," Paris, 1844. 11. Fighting top of the French battleship "Carnot," 1896. 12. Control platform of a British battleship, 1905. 13. German regulation fighting top and mast of 1907. 14. Maintop of H. M. S. "Dreadnought," 1907.

THE EVOLUTION OF THE MILITARY MAST.

we are now entering upon a period of almost mastless fighting ships. Some turn in the evolution of the perfect man-of-war may possibly cause history to repeat itself, as it has a way of doing, in which case we may again see, as in the days of yore, the fighting top pouring its missiles upon the decks of an opponent.

In our illustrations there are shown several types of fighting tops, which illustrate the developments from the earliest times to the present. It will be noted that in the case of the very latest military mast, as used on the later ships built for our navy, not only has the fighting top entirely disappeared, its place being taken by a simple platform for the fire-control officers, but the structure and appearance of the mast has been totally changed. Up to the time of the appearance of the British "Dreadnought," modern military masts consisted of a single vertical, hollow cylinder of steel of greater or less diameter, according to the fashion of the particular navy to which the vessel belonged. The masts of the "Dreadnought" consist each of three masts formed into a tripod, this form being used as a protection against the complete wrecking of the mast by a single shell, something that might readily happen to a single mast. The Bureau of Construction of our own navy have improved upon the masting of the "Dreadnought," by using the type shown in our engraving, which consists of a series of intersecting steel tubes, rising in spirals from deck to platform, 120 feet above the sea. One-half of the tubes have a twist from left to right and one-half from right to left. The basket-like structure thus formed offers great resistance to complete destruction by gun-fire, for several of the tubes might be cut through without endangering the stability of the whole mast. Unfortunately these good qualities are obtained at the expense of ship-shape appearance—for anything less nautical than these gigantic baskets it would be hard to imagine.

THE AERONAUTIC SOCIETY'S FIRST EXHIBITION.

On Election Day, Morris Park, which has been the scene of many horse and automobile races, was opened as an aeronautic ground by the Aeronautic Society. The society's first exhibition was held in the afternoon in conjunction with the championship motorcycle races of the Federation of American Motorcyclists, and while nothing especially novel happened in the aeronautical line, there were some very fast motorcycle races and some interesting experiments with gliders.

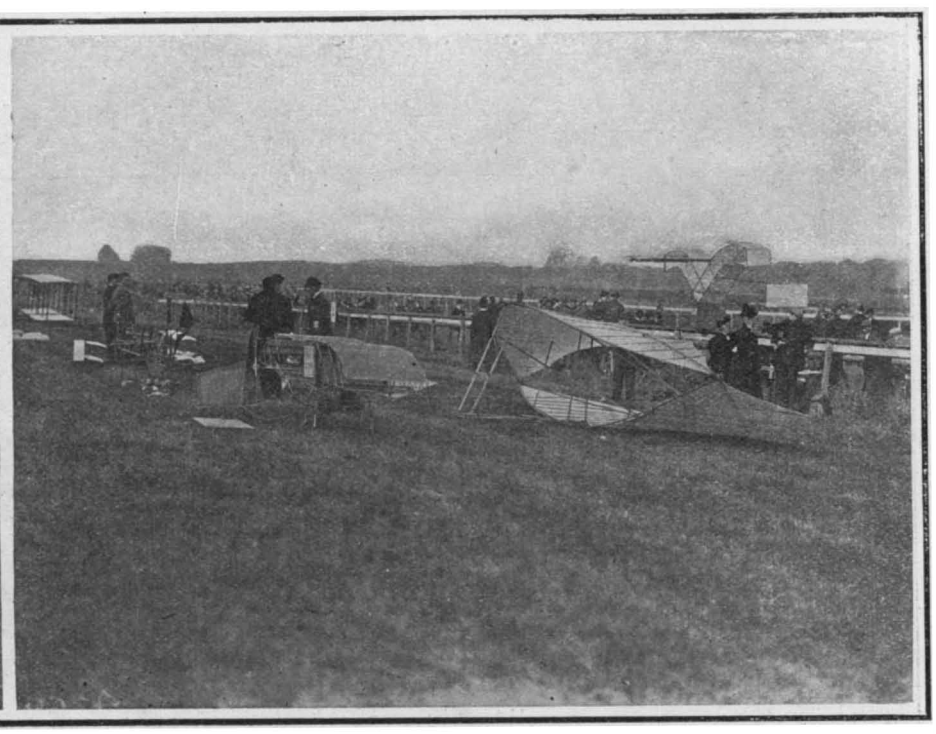
A considerable number of inventors were present with models of their apparatus. They were invited to place their models upon the lawn in front of the grand stand, where they could be inspected by the spectators. One of our photographs shows some of the apparatus as it was displayed upon the lawn. In the foreground is seen the double-surface glider of Laurence J. Lesh, the sixteen-year-old Canadian, who made sensational flights during the past summer above the St. Lawrence River, when his glider was towed by a motor boat. This glider is an improved apparatus designed by Mr. Lesh after numerous experiments and consultations with Mr. Octave Chanute, with whom he has collaborated.

The general appearance of the Lesh glider is similar to that of the "June Bug" aeroplane, but the glider is distinctly novel, in that the upper surface is placed considerably in advance of the lower one, which does away with nearly all interference. The machine has 120 square feet of supporting surface, and it carries 1½ pounds per square foot. At the first trial Lesh made a successful glide and alighted safely, but the second time he rose sharply to a height of about 40 feet, and then, losing his equilibrium, plunged downward to the ground at a sharp angle, breaking his leg just above the ankle in alighting. The accident was caused by lack of experience with the glider, which was not fitted with rudders as the previous ones had been.

The lower pair of photographs which we reproduce illustrate an improved type of aeroplane, which was invented some three years ago by Gustave Whitehead, of Bridgeport, Conn., and which has since been patented both in the United States and abroad. This machine, owing to its long triangular body with a bow at the forward end and a tail at the rear, is far more stable when in the air than is the Chanute double-surface machine. The foldable wings resemble those used by Lilienthal, with whom Whitehead at one time experimented in Germany. The main feature of the machine is the central body portion. A glider of this type can be made to lift a man when it is towed by another man against a fifteen or twenty-mile wind, and once it is well up in the air, the rope can be cut, and the machine will always alight on a level keel. Should it start to plunge downward, it will immediately right itself automatically. The aviator does not have to balance it by kicking out his legs, and it is possible to tow one of these machines behind an automobile with perfect safety to the man hanging from it.

The 'Round-the-World Thomas car towing Laurence J. Lesh in his glider.

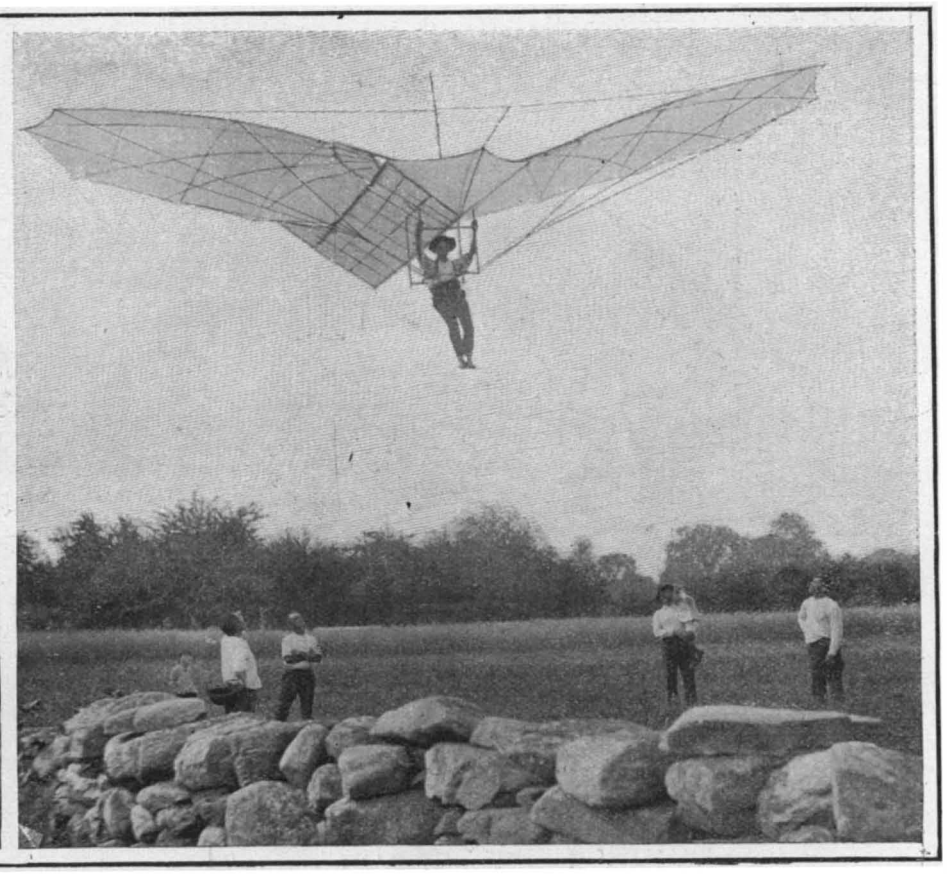
This was the first time Mr. Lesh had been raised by an automobile, though last summer he was towed 10 miles above the St. Lawrence River by a fast motor boat.



Gliders and models exhibited on the lawn.

Ordinary 2-surface glider. Farman type model of Percy Pierce. Model aeroplane of Miss E. L. Todd. Lesh's glider. Large model aeroplane of Arthur Mitchell.

Side view of Whitehead glider in free flight.



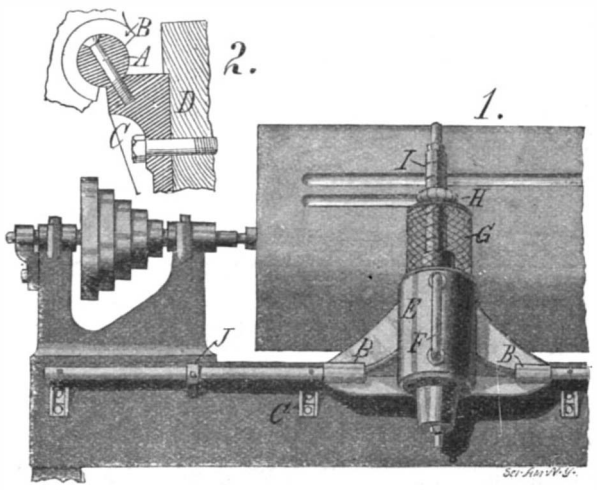
Front view of Whitehead aeroplane making a glide.

THE FIRST OPEN-AIR EXHIBITION OF THE AERONAUTIC SOCIETY.

Patent Department

FLUTING AND BEADING ATTACHMENT FOR LATHES.

Pictured in the accompanying engraving is an attachment that can be applied to a woodworking lathe,



FLUTING AND BEADING ATTACHMENT FOR LATHES.

to form flutes or beads on columns and the like. The construction comprises a guide bar *A*, on which is mounted a casing *B*. The guide bar is supported at suitable intervals on brackets *C* which are fastened to the body *D* of the lathe. Fitted in the casing *B* is a motor *E*. The armature shaft of this motor extends upward and carries a cutter *H* which is of suitable form to cut the flutes or beads. This cutter may be secured at any desired point on the armature shaft by fitting a number of washers *I* above and below it and clamping them in place with a nut threaded on the end of the shaft. An adjusting screw is fitted under the motor *E* and engages the casing *B* in such manner that it may be operated to adjust the motor with respect to the casing and thus raise or lower the cutter *H*. The motor is provided with a handle *F* which enables the operator to slide the motor along the guide rail and to swing the motor on the guide rail so as to move the cutter *H* into engagement with the work. To protect the workman from the moving parts of the machine, a wire screen *G* is provided. On the guide rail *A*, stop collars *J* are fitted which may be secured by means of set screws at any desired point to limit the motion of the motor along the rail. After the work has been turned down in the lathe it remains truly centered while being fluted or beaded so that separate handling of the work from a lathe to a fluting or beading machine is dispensed with. A patent on this improved fluting and beading attachment has been secured by Mr. C. R. Voorhies, 1509 Belmont Avenue, Mount Tabor, Ore.

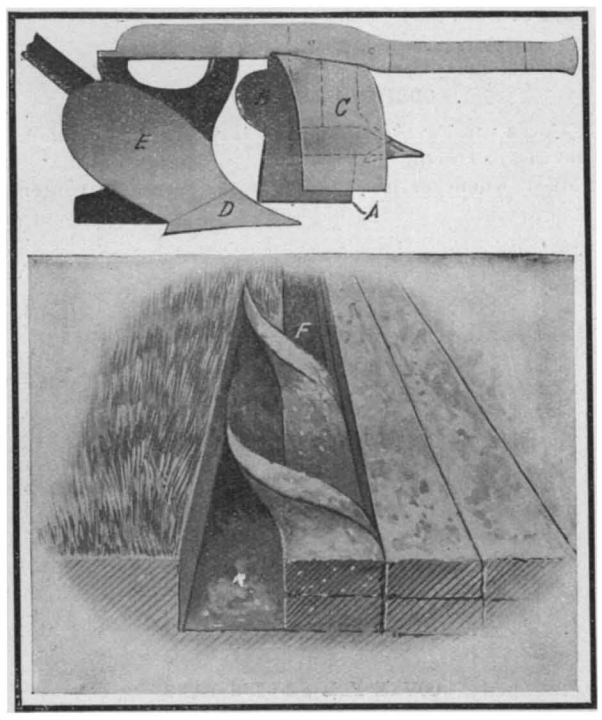
COMBINED PONCHO AND TENT.

Illustrated in the accompanying engraving is a tent which, when disassembled, may be converted into one or more ponchos, thus enabling it to be conveniently transported, and making it of particular value to troops, huntsmen, and campers generally. The tent is made up of sections, preferably triangular in form. A single section may be set up as a shelter tent, as indicated in Fig. 1. Each section is provided along its side edges with buttons and buttonholes, one-half of each edge being formed with buttonholes and the other half with buttons, so that a section may be folded upon itself, and buttoned together to form a bag. In the center of each section is a slit, provided with an elastic neck band, and when the section is formed into a bag it may be slipped over a person, with his head fitted through the slit. Armholes are formed at a convenient location on the section, and thus the section may be converted into a poncho, as shown in Fig. 3. When a number of hunters are provided with ponchos of this description, the sections may be buttoned together to form a larger tent of the Sibley type, as shown in Fig. 2. The material of the tent is waterproof, so that it provides the hunter with a weather-proof garment. The inventor of this combined poncho and tent is Mr. Frank H. Gotsche of 416 Hoffman Avenue, San Francisco, Cal.

COMBINED PONCHO AND TENT.

PLOW FOR TURNING THE SURFACE SOIL UNDER THE SUBSOIL.

The plow which we illustrate herewith is arranged to cut two slices of soil as it passes through the earth, one from the surface soil and one from the subsoil. The first layer is turned over into a ditch cut by the previous run, while the second layer of subsoil is turned over on to the first layer. In this way seeds and weeds are completely buried, while the rich subsoil is brought to the surface. The plow is formed with two shares, one placed in front of the other, and the rear one making a deeper cut. The forward share is of such form as to force the layer of soil it cuts to one side, and at the same time turn it over. The form of this share is shown in the drawing. It is provided with a downwardly projecting guide fin *A*, which is curved and offset outwardly. The body of the moldboard *B* inclines upward and outward, and terminates in a curved bow or horn *C*. The horn *C* extends completely over to the outer side of the furrow, and runs

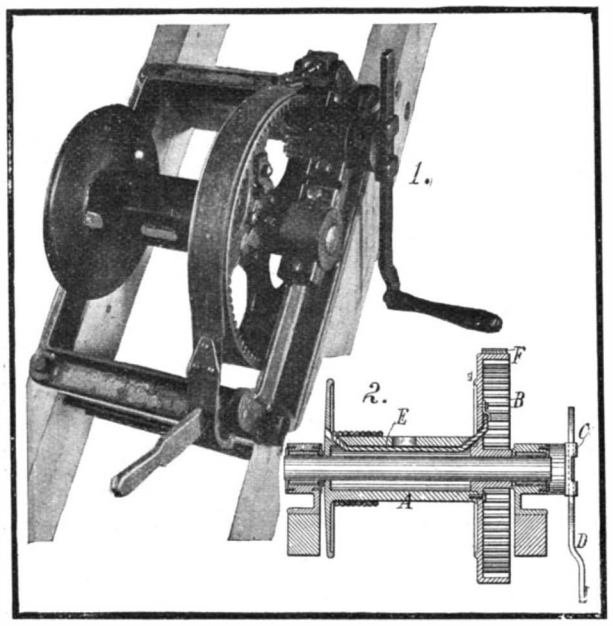


PLOW FOR TURNING THE SURFACE SOIL UNDER THE SUBSOIL.

along against the side of the furrow, acting as a guide. Immediately back of the front share is the second share *D*, which cuts into the subsoil to the rear. This is provided with the usual moldboard *E* and the guide fin *F*, adapted to hold the plowshare in the furrow. Fig. 2 illustrates the way in which the slices are cut from the earth, and turned over into the ditch or furrow *F* previously cut. A patent on this plow has been secured by Mr. Thomas Sawatzky of Herbert, Saskatchewan, Canada.

AN IMPROVED WINCH.

A recent invention provides an improved type of hoisting winch, such as used by riggers. This improved winch is constructed very simply and with a reduced amount of gearing, the latter being arranged to provide a surface for applying a brake band. It consists of a rectangular frame cast in a single piece. Mounted in roller bearings in this frame is a shaft which carries a drum *A*. This drum is formed at one end with a flange, while to the opposite end is secured an internal gear *B*. A pinion engages this gear, and the stub shaft on which this pinion is formed is provided at its outer end with a pair of slots *C*, into which is fitted a hand lever *D*. This hand lever may be freely moved in the slots, to shorten or lengthen the leverage. The advantage of this adjustment lies in the fact that, as the rope is wound on the drum, the successive layers of rope grow larger in diameter, and a longer crank is necessary to operate the winch. The rope is attached to the drum by passing it through a slot *E*, and securing it to a clip on the inside of the internal gear. The outer periphery of the gear is fitted with a brake band *F*, provided with an operating lever, as shown. The advantage of using an internal gear is that it gives better contact of the intermeshing teeth. The large gear being applied directly to the end of the drum does away with torsion on the shaft incident to the ordinary method of placing the gears outside of the bearings. This same system of

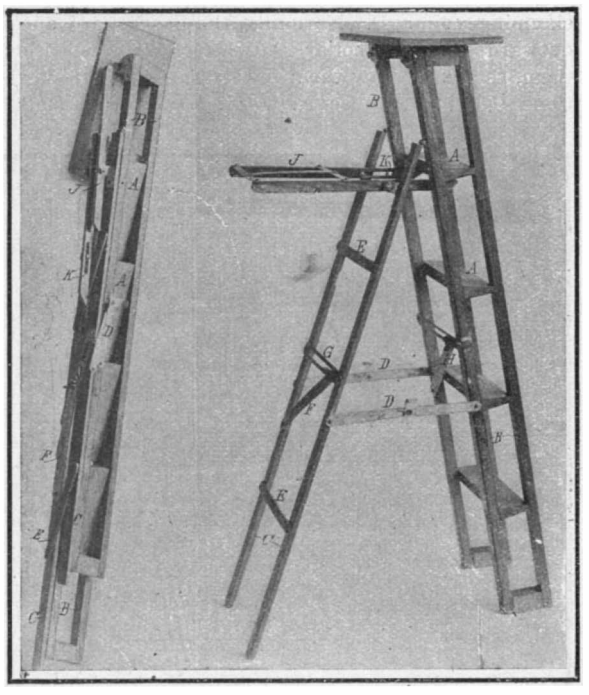


AN IMPROVED WINCH.

gearing may be used with a wheel and endless rope instead of the crank. A patent has been granted to Mr. Volney W. Mason of Lafayette Street, Providence, R. I., on this improved hoisting winch.

COLLAPSIBLE STEP-LADDER.

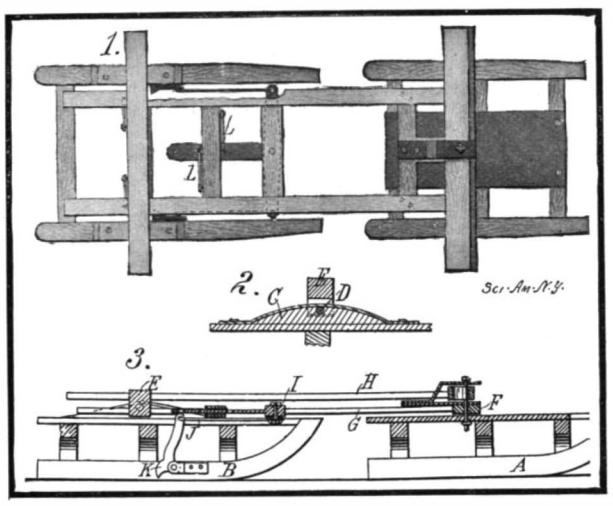
The ordinary step-ladder is arranged so that the supporting legs may be folded against the ladder proper, but the ladder here illustrated is arranged to be further folded, so that the sides will collapse one against the other. In this way the ladder will be made to occupy a minimum of space, facilitating storage or transportation. All the parts are connected, while in the collapsed position, so that the ladder may quickly be set up for use as shown in Fig. 1. The treads or steps *A* of the ladder are hinged at each end in the skeleton side rails *B*. The supporting legs *C* are hinged to the side rails in the usual way, and are provided with braces *D*, which serve to hold them in their open position. The supporting legs are connected by means of cross pieces *E*, which are pivoted thereto, and the two legs are kept apart by means of a diagonal brace *F*, which is provided with a stud that engages a slot in the cross piece *G*. By means of a thumb nut the diagonal brace may be clamped to hold the parts in the spaced position. A similar diagonal brace *H* is provided, to keep the side rails properly spaced apart. At the upper end of the ladder is a platform *J*, which is pivoted to the supporting legs, and is formed with extensions which engage the under side of one of the steps. One of the arms of the platform is provided with a slot *K*, through which the pivot pin passes, so as to permit of folding the parts. When folding the ladder this platform is first swung on its pivot, and then the supporting legs are folded against the side rails. Thereafter the thumb screws of the diagonal clamps are loosened, permitting the side rails to be folded against each other, as indicated in Fig. 2. The inventor of this collapsible step ladder is Mr. William J. Blundell of Brooklyn, N. Y., P. O. Box 182.



COLLAPSIBLE STEP-LADDER.

BRAKE FOR BOB SLEDS.

The sled which is shown in the accompanying engraving consists of a pair of bobs, which are connected together in such a manner that upon relaxing the draft strain, or causing the draft animals to hold back the front bob, a positive braking action will be effected. In the illustration the forward bob is shown at *A*, and the rear bob at *B*. The upper rails of the

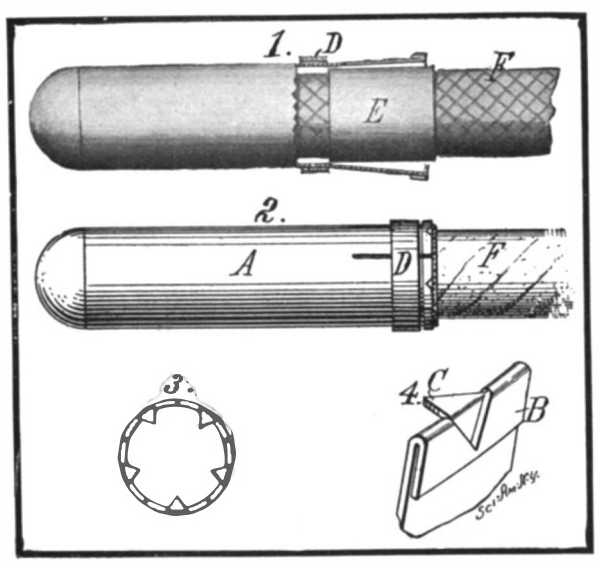


BRAKE FOR BOB SLEDS.

rear bob are formed with curved reinforcing pieces *C*, which are slotted to receive the pins *D* (Fig. 2). These pins *D* are fitted into the bolster *E*, providing a rocking connection between the latter and the bob. The forward bob is provided with a bolster *F*, which is connected to the rear bolster by means of side bars *G*. The latter are not fixed to the bolster *E*, but are slidably engaged therewith. Above the bars *G* is an auxiliary bar *H*, rigidly connecting the bolster *E* to a slotted bolster above the bolster *F*. A coupling pin connects the bob *A* with the two bolsters. In operation, when the strain on the forward bob is relaxed, there will be a relative motion between the two bars *H* and *G*. The bars *G* are connected to a cross piece *I*, which in turn is connected by links *J* to a brake arm *K*. When the rear bob rides forward with respect to the front bob, the brake arms *K*, which are pivoted to the rear bob, are swung on their axes by the relative motion of the bars *G* with respect to the bars *H*. Each of the brake arms is formed with a curved toe, which by this action is brought in contact with the ground, retarding the motion of the rear bob. The cross arm *I* may be adjusted with respect to the bars *G*, and secured by the hooks *L*. This mechanism is particularly adapted for use on bobs that carry heavy loads. The inventor is Mr. Eben G. Doland of Starksboro, Vt.

WATERPROOF FUSE CAP.

The invention which is illustrated in the accompanying engraving is adapted to be attached to the fuse of an explosive cartridge, such as is used in blasting in mining. The purpose of the attachment is to keep the end of the fuse substantially water-tight, so as to prevent the occurrence of "miss-fires" or "miss-holes" in blasting, which are due largely to the fact that the explosive in the cartridge becomes wet. The fuse cap consists of a shell *A*, which is closed at one end, while the other end is slitted to form a series of leaves. The ends of these leaves are bent back, as indicated at *B*, and are provided with projections *C*, extending inward. These projections are preferably formed by cutting V-shaped pieces in the turned-back portions of the leaves, and bending them inward at right angles to the leaves. Fitted over the shell *A* is a clamping collar *D*. Normally the leaves are sprung outward, and the collar *D*, when it is slipped over them, serves to draw them inward, pressing the projections *C* into the fuse *F*. Fitted over the fuse and

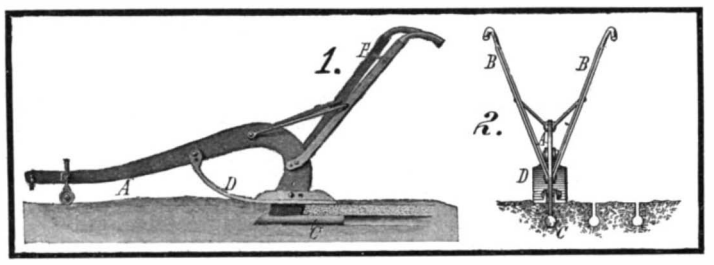


WATERPROOF FUSE CAP.

under the leaves of the shell is a rubber sleeve *E*. This serves to prevent moisture from entering the shell through the slits. The projections *C* press into the fuse at the outer end of the rubber sleeve, so as to prevent the latter from working out. Mr. Thomas N. Daniels of Valdez, District of Alaska, has been granted a patent on this waterproof fuse cap.

NOVEL TYPE OF PLOW.

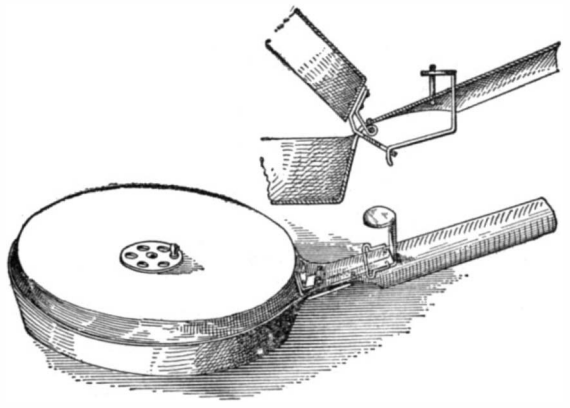
The plow which is illustrated in the accompanying engraving is designed to open up the ground below a furrow, so as to form a conduit in which the moisture will be retained and an excess of moisture will be drained off. In times of drought, the circulation of the air beneath the roots of the plants will draw down any moisture in the atmosphere, and promote their growth. After a fairly good rainfall, the conduit below the furrow will accumulate a certain amount of water, which will be sufficient to keep the roots of the plant moist. The plow is of very simple construction, and quite similar to the ordinary. It consists of a beam *A*, with the usual handles *B*, but the plowshare *C* is designed to travel entirely underground. The form of the plowshare is preferably circular in cross section, and is tapered at its forward end in such direction as to hold the share down in the ground. To prevent the share from digging down too deeply, a guide *D* is provided, attached to the beam *A*, which is formed with a pair of flanges that rest on the surface of the ground. We are informed that this plow has been in use, with very favorable results. The crops which have been grown over these underground conduits have shown a remarkably increased yield. The plow can be attached behind an ordinary rotary plow, thus reducing the expense of operating it. The inventors of this plow are Messrs. S. F. Vose and C. R. Harryman of Shawnee, Okla.



NOVEL TYPE OF PLOW.

ODDITIES IN INVENTION.

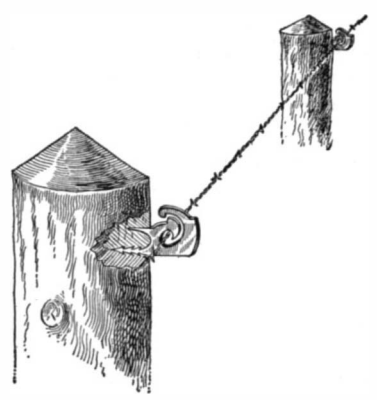
Cover for Frying Pans.—An inventor in Chicago has devised a frying pan with a cover which may be raised, whenever it is desired to examine the contents



COVER FOR FRYING PANS.

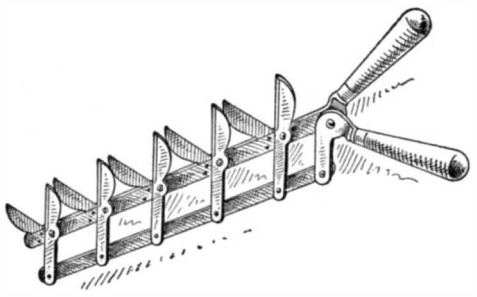
of the pan, without danger of burning one's fingers. The cover is formed with an extension, which passes through the handle of the pan. A thumb piece is attached to this extension, and passes vertically through to the upper side of the handle. The cover may then be opened by depressing the thumb piece. Hinged to the handle is a catch, which may be swung over the thumb piece to hold the latter in its depressed position when it is desired to keep the cover of the pan open.

Simple Wire Fastener.—Pictured herewith is a simple device for fastening fence wire, or the like, to posts. The advantages of this fastener are that it may be placed in position on the post before the wire is attached thereto, and that its construction is such as to prevent the wire from being accidentally disengaged from the fastening. The fastener is stamped out of sheet metal and is formed with two spurs, one of which is barbed to prevent it from leaving the post after it has been driven in. The projecting part of the fastener is formed with a spiral opening, into which the wire is introduced. A pair of coacting shoulders at the entrance of the spiral opening prevent the accidental disengagement of the wire.



SIMPLE WIRE FASTENER.

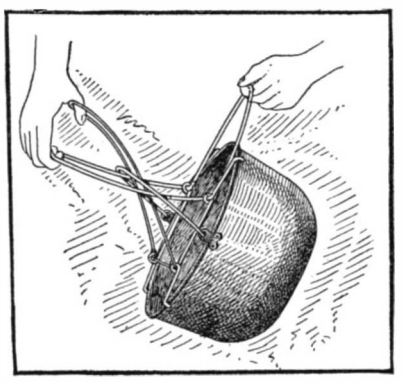
Shrubbery Cutter.—In order to reduce the labor usually involved in trimming a hedge, an inventor has recently devised a multiple-bladed cutter, which will operate over a wider area than the ordinary shears. The device consists of two bars, on one of which are a series of fixed cutting blades, while the movable cutting blades are fulcrumed on the same bar, but have their opposite ends connected to the second bar. The latter bar is provided with a handle in the shape of a bell crank, which is fulcrumed to the other bar close to the handle of this bar. When the handles are operated, the two bars move toward and from each other with a parallel ruler motion, and the series of



SHRUBBERY CUTTER.

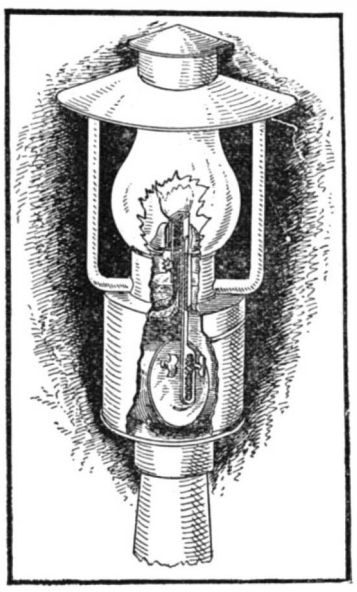
cutting blades are caused to open and close, in the manner of the ordinary shears.

Kettle Tilter.—A simple device is illustrated herewith, which may be used to tilt a kettle in which vegetables or other food is being cooked, so that it may be drained without scalding the hands. The device consists of a pair of wire arms, which may be fitted to grip the edges of the kettle. These arms are provided with a pair of handles, which are crossed under the bail of the kettle. A third handle may be seized in one hand, while the other two handles are grasped in the other hand. The kettle will thus be firmly gripped, and it may be tilted to any desired degree with perfect safety.



KETTLE TILTER.

Automatic Lamp Extinguisher.—An inventor residing in South Dakota has invented a simple device, which may be attached to an oil street lamp such as is used in a village or town, to extinguish the light at any hour set. The device consists of a sleeve which is arranged to slide over the wick, to extinguish the lamp. This sleeve is connected by a rod to an alarm clock. A pinion on the winding key of the alarm engages a rack carried by the rod. When the hour arrives for the light to be extinguished, the alarm mechanism is disengaged, causing the key to turn in the usual way and thereby feed the sleeve upward, so that it covers the wick and extinguishes the flame.



AUTOMATIC LAMP EXTINGUISHER.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT HANGER.—R. C. THOMAS, New York, N. Y. This garment hanger is constructed with two arms, each made of two strands with their inner end twisted and adjustably pivoted to the other arm. At the outer end of each arm is a shoulder loop made longitudinally adjustable through the intermediary of a connecting block.

Electrical Devices.

SPARK-PLUG ATTACHMENT. — F. D. CASEY, North Water Gap, Pa. The object of this invention is to provide covers for the spark plugs of engines to prevent water or moisture from reaching the electrical connections on the spark plugs and thereby cause a short circuit. The device is particularly adapted for the engines of motor boats and motor vehicles.

TRANSPOSITION BRACKET FOR INSULATORS.—J. E. SKINNER, Kingman, Kans. The purpose of this invention is to furnish means for transposing telephone wires at suitable intervals, so as to equalize induction effects on the several wires. The invention provides a device which may be supported by the wires themselves without the addition of extra cross arms on the pole.

Of Interest to Farmers.

FENCE POST.—A. M. WEATHERLY, SR., Rome, Ga. The present invention is an improvement on a fence post previously patented by Mr. Weatherly. It is arranged to be cast in a single piece. Its form is such that it may be used as a corner post, as well as being provided with pockets or recesses which are closed at the back and separated by a recess extending at right angles to the above-mentioned recesses.

Of General Interest.

SMOKING PIPE.—W. R. KAUFMAN, Sulphur, Okla. This tobacco pipe is provided with a bulb in the stem which is adapted to trap the saliva. In the bulb is a central partition of screen material which strains, dries, and cools the smoke to be strained and dried. When desired the bulb, which is composed of two sections screwed together, may be opened and cleaned.

PLUG FOR GAS WELLS.—W. F. BURGESS, Atwood, W. Va. The invention provides means for plugging gas wells whose yield of gas has ceased. It consists of a hollow tapered body portion with devices slidable thereon and adapted to wedge and lock the body in the well, and an elastic extensible sleeve or cylinder fitted with a tapered plug which is slidable in the body and thus adapted to extend the sleeve.

TRAP.—A. O. THOMPSON, Wolverton, Minn. This trap consists of two ring-shaped jaws which are spaced apart to make room for an intermediate opposing jaw that operates between them. A simple latch is provided to hold the intermediate jaw and a trigger arm on this latch extends across the ring-shaped jaws so that it will be sprung by an animal endeavoring to pass through the jaws.

PRESSURE REDUCER FOR GASEOUS VAPORS.—H. A. REED, New York, N. Y. This invention provides a pressure reducer for ale, beer, and similar liquids, and has for its object to reduce the pressure of the fluid in drawing it from the barrel or cask so that the gas and liquid will pass out in proper proportions without waste of the gas, thus obviating the danger of the beverage becoming flat.

CALENDAR.—J. FERRERES, Habana, Cuba. This calendar is of the type provided with two members rotatable with respect to each other, one of the members bearing the names of the days of the week and the other the numerals of the days of the month. The calendar invented by Mr. Ferreres is so arranged that the names and numerals will be right-side up and easily read irrespective of the extent to which the rotary member is turned.

COLUMN.—C. T. CUNNIUS, Long Branch, N. J. Stave columns as generally constructed are apt to break at the joints and warp apart. The present invention aims to overcome this difficulty by constructing the column of a plurality of staves, all of approximately the same taper, with one stave having an inner and outer section, substantially equal to the length of the other staves. Through the staves a band is circumferentially passed with the ends emerging at the inner section of the sectional stave, where they are joined, to bind the staves together. The outer section is then applied to cover the joint.

ATTACHMENT FOR SEINES. — N. L. LERILLE, Lockport, La. The object of the invention is to provide a stake which is to be used to secure the ends of the seine in place while the seine is being hauled. Means are provided for holding the seine close to the mud without damage to the seine. The stake is fitted with a number of points of different length, which may be applied as may be necessary for use on different bottoms where the depth of mud varies.

FILTER.—VIRGINIA TONINETTI, Milan, Italy. This filter is provided with two chambers, the upper one having a number of spouts projecting into conical holders supported in the lower chamber. These holders are adapted to be fitted with filtering material. The filtered liquid issues from the holders into the lower chamber, where it may be tapped off as desired.

CONSECUTIVE NUMBERING APPARATUS.—C. SPIELMAN and F. W. WICHT, New York, N. Y. The object of this invention is to provide an improved consecutive numbering apparatus fitted with a number of sets of numbering wheels, actuated simultaneously and of which any set may be placed in print in either a transverse or a lengthwise direction. The sets may be adjusted toward or from each other and quickly fastened in the adjusted position.

HEDGE TRIMMER.—F. L. GILMAN, Engene, Ore. This hedge trimmer is of the hand-operated type, consisting of a hand-operated mechanism which may be strapped to the person and a many-bladed cutting shears operable by this mechanism and adapted to be guided by the hand along the hedge.

TIE FASTENER.—J. P. CHAMBERS, Chattanooga, Tenn. This invention provides a simple flexible member which may be used to rapidly secure the ends of a cord tied about a package. It is particularly adapted for tying packages of letters and the like, and should be useful for the mail service as well as for lawyers, bankers, insurance men, and the like, where numbers of packages of papers are kept on file. The particular advantage of the tie is that it holds the ends of the cord in such a way as to permit the package to be untied at a moment's notice.

COIN-CONTROLLED LOCK.—F. W. KASSLER, St. Louis, Mo. This invention relates to a coin-controlled lock adapted particularly for use in connection with public telephone booths, the object being to insure the payment of tolls. The lock is provided with means for closing the coin chute when a person is using the booth so that it is impossible for any other person to interfere with the lock.

GAME PIECE.—F. WALSTEIN, New York, N. Y. This game piece is adapted for use in out-of-door apparatus for playing chess, checkers and the like. It is arranged to permit of conveniently moving the piece about over the game board and to securely hold the same in position in a field of the game board when at rest.

HITCHING-WEIGHT HOLDER. — H. H. TOTHILL, Lockport, N. Y. A means is provided by this invention for supporting a weight employed temporarily for putting a check on a hitching strap. The weight is hung from the floor of the vehicle body. Normally it clears the ground, but when desired the driver may release the weight, without leaving his seat, and permit it to fall to the ground.

FLASHLIGHT FOR PHOTOGRAPHIC USE.—E. B. MOORE, Los Angeles, Cal. When photographing an object by means of the ordinary flashlight, the high lights are apt to be accentuated and there is a sudden change to the deep shadows without any middle tones. The present invention aims to overcome this objection by providing a source of illumination having a relatively large area. In this way the harsh effect produced by an arc light or common flashlight in which the light emanates from the concentrated point is largely overcome.

COMBINED LADDER, STEP LADDER, AND SCAFFOLDING.—H. H. THOMPSON, Lawrence, Kans. The invention provides a ladder which may readily be converted into a step-ladder or may be employed as a portion of a scaffolding. The present invention is an improvement on a construction previously patented by Mr. Thompson. The design is such that two ladders may be connected so as to serve as the support of the scaffolding.

Machines and Mechanical Devices.

SOUND REPRODUCER.—W. A. CHAPMAN, Smithville, Ark. This sound reproducer is particularly useful in connection with talking machines of the disk type. Its object is to provide an efficient sound reproducer which will eliminate harsh, shrill, and metallic tones and exactly reproduce the volume, register, and tone shading of the original sound.

CALCULATING MACHINE.—E. LEDER, Berlin, Germany. The object of this invention is to provide a machine by means of which the logarithms of numbers can be ascertained, and logarithmic calculations be effected. With this machine ordinary arithmetical calculations can be made rapidly and accurately by the employment of logarithmic principles.

TALKING MACHINE.—W. A. CHAPMAN, Smithville, Ark. The invention provides means for supporting the sound tube of a talking machine so that the tube is free to swing in two directions without interrupting the propagation of the sound waves through the sound tube and the horn which communicates therewith.

WASHING MACHINE.—J. BECKER, Canal Dover, Ohio. A strong and efficient washing machine is provided by this invention which can be manually operated, which can be adjusted to adapt it for use with varying quantities of articles to be washed, and which can be taken apart so that it can easily be shipped or stored when not in use.

COMPUTING BALLOT BOX.—C. A. BALL, Marion, Ind. This computing ballot box is specially adapted for use of fraternal and benevolent societies, lodges, clubs, and the like, whereby a more reliable and secretive method of conducting the election of applicants for membership is obtainable than at present. The invention provides a method of conducting a secret, affirmative, or negative ballot, without the aid of tellers or the use of paper ballots.

Prime Movers and Their Accessories.

AUTOMATIC STARTING VALVE.—J. B. LANE, Glenwood Landing, N. Y. The invention relates to improvements in machines for controlling the pressure in conduits, containers, and the like, and more particularly relates to that type of controller in which the flow of liquid through one conduit, for instance a motive fluid for operating a pump, is controlled by the pressure in a separate conduit or container, for instance, air compressed by a pump operated by the motive fluid.

ENGINE STARTER.—L. S. TUTTLE, Eastport, N. Y. A hand-operated starting device for internal combustion engines is here provided in which danger while cranking the engine due to back firing will be eliminated. The crank automatically operates to release the driven shaft or other mechanism for driving the engine, should the engine back fire, and it is ejected from the shaft as the engine starts in the proper direction under the influence of its motive agent.

Railways and Their Accessories.

CAR COUPLING.—O. L. ALBERTSON, Richmond, Va. The invention relates to an improvement in car couplings of the twin jaw type and provides an improved method of interlocking the jaws so that when closed they will not exert any pressure upon the opening lever.

MAIL BAG CATCHER AND DELIVERER.—W. R. MORRISON, Derry, N. H. Mr. Morrison's invention is an improvement in devices used on railways for receiving mail sacks from a passing train and delivering the same thereto. The device is arranged to relieve the impact of the mail bag so that injury to the same or the crane will be avoided.

TIE PLATE.—F. A. PIPER, Redlands, Cal. The invention provides a strong and inexpensive tie plate formed of sheet metal and having shoulders at the ends to engage the outer edges of the rail bases. The plate is provided near the ends with openings to receive the spikes at opposite sides of the rail, and with laterally disposed flanges constituting spurs which are forced into the tie to secure the plate thereon.

CAR MOVER.—C. H. SHOTWELL, Akron, O. This car mover consists of a lever composed of two members which are pivoted together, the fulcrum being adjustable to operative position after the load arm has been disposed against the car wheel. The load arm, which serves as a shoe, has a surface which conforms with the configuration of the tread of the car wheel. The device may be attached to the periphery of the car wheel in such manner that when power is applied to the lever it will be locked to the wheel and turn with it.

METALLIC RAILROAD TIE.—A. M. BAIRD, Topeka, Kans. The present invention is an improvement on a construction previously patented by Mr. Baird. It is provided with an open channeled body and is fitted with metallic clamps for the rail, the clamps being secured in cross pieces or top plates connecting the sides of the channeled body. The tie is particularly adapted for use on sharp curves of a railroad or any other portion of the road bed that may incline more or less laterally. The tie body is fitted with wings or lugs which prevent endwise creeping.

RAIL BENDER.—D. BELLONI, Edri, Pa. This device is designed for bending the rails or track to the necessary curve or for straightening the rails. It belongs to that class of benders in which a bowed yoke with hook shaped ends is provided at the center with a screw-threaded enlargement adapted to receive a screw stem which passes through the enlargement and bears against the rail at a point midway between the hooks of the bowed yoke.

Vehicles and Accessories.

MOVING VAN.—A. B. YETTER, New York, N. Y. The invention provides an extension for the rear end of a moving van whereby the capacity of the van may be increased whenever necessary, and which will protect articles ordinarily strapped outside the end of the van. The attachment is adaptable to any type of van and will not interfere with the opening or closing of the doors.

TRACTION WHEEL.—F. BOTTRILL, Tintinara, S. Australia, Aus. This invention has been devised to facilitate the movement of traction engines over sandy or yielding surfaces, and its novel features consist in the provision of a series of oscillating bearers, flexibly mounted upon and attached to the wheel rim in one or preferably two circles, the bearers in each circle being arranged end to end between suitable flanges extending around the rim.

Designs.

CLOCK STAND AND PICTURE FRAME.—G. KEPPLER, New York, N. Y. The design consists of an ornamental frame supported by a pair of legs in the form of dolphins. The frame is provided with a shell effect at the upper end, while at the sides are conventional flower effects.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

The full name and address must accompany all letters, or no attention will be paid thereto. This is solely for our information. *All* queries are answered by mail, and a *few* of the selected answers are afterward published in the paper. We cannot undertake to furnish information on matters of personal interest, without reasonable compensation. To answer questions which are not of general interest usually costs us from $2.00 to $3.00 each upward, and this sum should invariably be remitted in such cases. When there are questions involving building or other construction, or when calculations must be made, an estimate of the cost will be furnished upon request. We cannot give answers to examination papers, or decide wagers, nor can we undertake to solve mathematical problems of any description whatsoever. Do not use postal cards.

Queries from this vicinity not answered within fourteen days should be repeated in full. Queries from points more remote will require a longer time.

We do not make chemical analyses; but we are always pleased to give the names of minerals which are submitted to us, when it is possible for us to do so. The minerals should be sent marked distinctly with the name of the sender, and should be sent fully prepaid.

Buyers wishing to purchase any article not advertised in our columns will be supplied with the addresses of the houses manufacturing or carrying the same, as soon as possible, or if we are unable to do so, their queries can be advertised in our special classified column.

Any books on any scientific or technical subject can be furnished. We solicit requests for quotations. The SCIENTIFIC AMERICAN SUPPLEMENTS referred to are mailed for ten cents each. Book and SUPPLEMENT catalogues will be sent free on request. A careful reading of these "Hints to Correspondents" will prevent any misconception as to the uses and will prevent abuses of this column.

(10980) C. H. C. says: Can you inform me of the philosophy of the curving of a tennis ball when struck with a "cut," and why some balls, with a forward twist, drop, and others, with a reverse twist, carry a long way without dropping? Is the cause gyroscopic action, or the result of the climbing motion of the ball against the air, or what? A. The curving of a tennis ball is probably due to the same cause as that of a base ball. The rotation of the ball is such that the air pressure is greater on the side toward which the ball rotates, pushing the ball in the opposite direction. See SCIENTIFIC AMERICAN, July 16, 1904, for a discussion of this question. This explains upward and downward motions of balls, as well as sideways motions. There is no gyroscopic action, so far as we can see.

(10981) C. E. D. asks: In your reply to query 9606, you state that daylight is gone after the sun is 18 deg. vertically below the horizon. It seems to the writer that this is an error. On almost any clear night in the latter part of June, the sun's light can be traced, decreasing as the hours pass, farther and farther north until the North Pole is passed, when it begins increasing until dawn. If this is not daylight, what is it? It is a well-known fact that the nights in summer are not so dark as in winter, and this must be because the daylight is not so fully excluded. A. You are quite right in supposing that the light seen in the sky after the sun sets is sunlight. It is reflected from the dust particles in the upper air. This is twilight, not daylight, since daylight implies the seeing of objects distinctly, while twilight implies a dim, indistinct vision. *Twi* here means *between*, that is, neither light nor darkness. The twilight zone is about 1,500 miles broad, to the east and west of the sunset line. At different times in the year a different time is required for the sun to reach an altitude of 18 deg. below the horizon. In our latitude this is more than two hours in midsummer, and the shortest possible duration of twilight in the torrid zone is one hour twelve minutes, all the year round. The writer has lived there, and seen the night fall almost as soon as the sun sets. Twilight is not reckoned upon for working in the torrid zone, as it is here in the summer. The twilight illumination of the sky swings around toward the north as the sun itself does, and in the most northern portions of the United States the twilight zone does not dip below the horizon, even at midnight. About latitude 48 deg. twilight of morning meets evening twilight at the north. Even in Montreal or Edinburgh the evenings of summer are very long, and the streets are filled with people much later in summer than with us. But wherever on the earth the sun is 18 deg. below the horizon, it is night, and no light of the sun is to be seen above the horizon. Another fact in this connection, is that the sky is never dark. This, however, is not due to the sun, but to the stars. The Milky Way is above the horizon in summer in our latitude, and it gives a great deal of light by night, enough to make the night sky of that time brighter than when it is not a part of our night sky, as is the case in winter. Then, too, the stars which cannot be seen by the unaided eye give us much light. The stars which are not visible to the eye give more light than those which are visible. We quote Todd's "New Astronomy," p. 424, on this point: "Accepting a sixth-magnitude star as the standard, and expressing in terms of it the light of all the lucid stars registered by Argelander (a catalogue of 324,000 stars to the 9½ magnitude), they give an amount of light equivalent to 7,300 sixth-magnitude stars. But cal-

culation proves that the telescopic stars of this extensive catalogue yield more than *three times* as much light as the lucid ones do. The stars, then, we cannot see with the naked eye, give more light than those we can, because of their vastly greater numbers." In the whole heavens the stars give about 1-80 as much light as the full moon. There is good reason for the fact that the sky is light all the night.

(10982) G. F. says: 1. Is there any sound when there is no ear to hear it? For instance, if a tree were to fall and there were no living thing within hearing, would there be any sound? Please explain fully. A. There may be *sound* when there is no ear to hear it, and the fall of a tree would produce exactly the same noise, whether or not there be any one near at hand. What we call "sound" consists in reality of pulsations or wave vibrations in the air or whatever medium the sound traverses. If a stone fell into a smooth body of water, it would produce waves on the surface of the water, whether or not there be any person present to see them. In the same way, it would produce waves or pulsations of sound in the air. 2. Give a rule for figuring the drawbar pull of a traction engine. As an example, figure the pull of the following engine: Cylinder, 10 x 10¼; 225 revolutions, cutting off at two-thirds stroke; pressure, 120 pounds; traction wheels, 64 inches diameter, geared 1 to 17. A. The engine which you describe ought to be able to produce a drawbar pull of from ten to fifteen thousand pounds for each cylinder, provided the driving wheels do not slip. If this force is more than eight or ten per cent of the weight on the driving wheels, they are likely to slip.

(10983) A. W. P. writes: 1. What is the complementary color of purple or violet? Is it green or yellow? A. The complementary color of purple is green. 2. Concerning wireless telegraphy, I have read that "the receiving antennæ should be about one-fourth the length of a wave." How may the length of the wave be determined? A. The length of electrical waves is dependent upon the number of oscillations per second of the discharge. With 300,000,000 oscillations the waves are about 3 feet long, since the speed of the waves is about the same as that of light. The mode of securing waves of a particular length is discussed in the several systems in Mayer's "Wireless Telegraphy," price $2. 3. Which is the best battery to use with a small induction coil (spark) for experimental purposes—one that will give a steady current and not annoy one by polarizing every few minutes? A. For experimental purposes you will find the plunging bichromate battery as satisfactory as any. A good form is described in our SUPPLEMENT No. 792, price 10 cents.

(10984) B. B. asks: Which part of a wagon wheel, when traveling on the road, goes the fastest, the top or the bottom? A. All parts of a wagon wheel go along the road with the same speed, the same as the horse moves. So too all parts of the wheel turn around the axle with the same angular speed, that is, every point which is at the same distance from the center moves with the same speed, but each point moves with a speed which is proportional to its distance from the center of the axle. The center line of the wheel does not rotate at all. There are other motions of the parts of a wheel which are discussed in Queries 9622 and 9635; also in the correspondence column of Vol. 92, No. 25, to which we would refer you. We can send you these numbers for thirty cents.

(10985) H. A. K. says: I have a hollow cylinder 1¼ inches diameter by 3 inches high. How many cubic inches of air will be compressed into it at 100 pounds pressure per inch? At 200, at 300, at 400, at 500? If the height of the cylinder is cut in half, how many cubic inches will it contain at the same pressures? What is the rule for finding the volume of air compressed into a given space at a given pressure? What books treat on the subject? A. Your cylinder contains 3.68 cubic feet of air at atmospheric pressure. At 100 pounds pressure it will contain 3.68 times $\frac{114.7}{14.7}$ = 28.8 cubic inches. At 200 pounds per square inch it will contain 53.8 cubic inches. At 300 pounds per square inch it will contain 78.8 cubic inches. At 400 pounds per square inch it will contain 103.8 cubic inches. At 500 pounds per square inch it will contain 128.8 cubic inches of air at atmospheric pressure. If you halve the height of the cylinder, you will halve the amount of air that it will contain. The pressure of the atmosphere on an average is about 14.7 pounds per square inch. When the pressure is increased, the volume of each cubic inch of air is decreased in the same ratio that the pressure is increased above 14.7. In working these problems it is necessary to remember that pressures as ordinarily measured by gages are pressures above the atmospheric pressure. To obtain the absolute pressure or true pressure, it is necessary to add 14.7 to the pressure given by the gages, as has been done in working the examples above. We recommend and can supply you with the following book relating especially to the subject you refer to: "Compressed Air: Its Production, Uses, and Application," by Hiscox, price $5 postpaid.

(10986) P. H. C. asks: 1. I ask you to explain in your column of Notes and Queries why a small battery motor will run on a 110-volt alternating current when a 50 candle-power lamp is put in series. If the 50 candle-power lamp is removed and a 16 candle-power put in its place, the motor will not start. A. A 16-candle lamp does not carry current enough to run your motor; a 50-candle lamp does. 2. How long a spark ought an induction coil to give which is 8 inches long, 7½ inches in diameter, the core being 1 inch in diameter, the primary coil consisting of two layers of No. 16 copper wire and the secondary coil containing 4 pounds of No. 36 copper wire? A. You may be able to get a spark 3 inches long from your coil, but its proportions are not of the best. The primary winding is of too small a wire. No. 12 would have been right. The coil is too short. It should have been 12 or 14 inches. This would have made the outside diameter less, and brought the secondary nearer the primary and into a stronger magnetic field. The coil might then have given a spark of four inches. See our SUPPLEMENT No. 1527 for plans for a 4-inch coil; price ten cents. 3. Having five known parallel forces applied at known points to a stick, what is meant by taking one of those points as the center of moments? A. When a point is taken at the center of moments, a force acting at that point does not assist in any way to rotate the stick. It simply produces pressure on the point. 4. What is meant by moments of forces? A. The moment of a force is the value of that force in producing rotation of the bar or wheel to which it is applied. The value of any force in moment is equal to the product of the force multiplied by the acting distance of the force. See textbooks of physics for full explanation of moments and forces.

(10987) E. De V. asks: Will you please tell me what kind of steel makes the best bar magnets? Also, I would like to know the relative strength of bar and electro-magnets. A. For permanent magnets some prefer Jessop's steel, some Stubs' steel, some manganese steel, and some tungsten steel. Probably any good high-grade steel will answer very well for the purpose, with little to choose. This is generally the case when there are so many opinions on a matter. There is no "relative strength" of permanent magnets. A good permanent magnet may lift five times its own weight. An electro-magnet will lift much more than this.

(10988) J. J. G. asks: Does an object which is viewed through the telescope of an engineer's transit appear to be larger than when seen with the naked eye? Although this may seem to you to be a foolish question, I find that several of my acquaintances, two of whom are graduate civil engineers, claim that while the image is clearer, it is no larger. By looking through the telescope with one eye and past it with the other, I am able to see both object and image at the same time, and thus seen the superficial areas appear to be about as 1 to 16. My friends claim that this is due to my eyes, but I do not think so. A. An engineer's transit usually is provided with a telescope which will magnify from 3 to 6 diameters, or from 9 to 16 times. If it did not magnify at all, an object seen through it would not be seen any more distinctly than with the naked eye. A simple way to determine the magnifying power of a glass is to look at bricks at some distance with one eye through the telescope and with the other eye directly. Find how many bricks seen with the naked eye are covered by one brick seen through the telescope. This is the number of diameters the telescope magnifies.

(10989) G. J. B. writes: In your Notes and Queries of April 1, 1905 (No. 9594), you say that the curvature of the earth is 8 inches for one mile and 32 for two miles. This is right (approximately) when running an east-and-west level but ceases to be true when running north and south, or else the doctrine that the north-and-south axis of the earth is 26 miles shorter than the east-and-west axis must be false. It is easily evident that if you run a level starting from a given point on the equator and running west through 90 deg. of arc with 8 inches allowance for each mile and should then start at the same place on the equator and run north through 90 deg. of arc, you would come out up in the air at the north pole. This would be equally true if you run the same levels with equal fore and back sights. A true instrumental level is a series of short chords whose ends are equidistant from the center of the earth, and paradoxical as it may seem, a true level is a true circle. It is literally true that the Mississippi River runs up hill, else its mouth could not be farther from the earth's center than the source. It is also true that no river of the same levels could exist in an east and west course, unless its source was underground and it should rise gradually to the surface. The levels of the Amazon River are most decidedly different from the Mississippi. A. Definitions are the safeguards of a discussion. Unless words are used in the same sense by both sides to an argument a discussion is not profitable. And when you state that "an east-and-west level is not the same as a north-and-south level" and that "the Mississippi River runs literally up hill" it is evident that the terms "level" and "up hill" need definition. We cannot agree to either expression in the sense in which the dictionary requires us to use terms. If we define level, probably the term up hill will take care of itself, since it must be defined as departing from a level by rising above it. The Century Dictionary, which is usually considered as good authority, defines level as "an imaginary surface everywhere perpendicular to the plumb line, or line of gravity, so that it might be the surface of a liquid at rest. Every such surface is approximately that of an oblate spheroid, as the sea level, for example, is." This seems very plain. We cannot think that anyone would maintain that the sea from the latitude of the source of the Mississippi to that of its mouth is uphill, yet if the river flows uphill surely the sea also flows uphill, and a ship sails uphill in the northern hemisphere here, as it sails south. A level is not a surface equidistant from the center of the earth, and is never defined as such. That would not be a level. Water would not lie upon such a surface, and a level run north and south does not differ from one run east and west. It is nonsense to say that a level is run differently in one direction from what is done in another. The only difference is that centrifugal force acts to modify the level north and south, but the liquid of a level, the ship on the sea and the waters of the flowing rivers, all are sensible to the action of this force all the time and everywhere. A level is the surface of still water, and the water of a south-flowing river at its source in the northern hemisphere is above the level of its mouth, and the water of this river flows down hill from its source to its mouth.

(10990) J. F. S. asks: Will you kindly explain how it is that makers of dry batteries rate their cells in amperes? Thus, they claim that a cell will show 14 or 16 amperes. I always supposed that an ammeter simply showed the *rate* at which current flows. This being the case, the reading on the ammeter would be dependent on the voltage and the resistance in circuit. Would it not be better practice to test cells with a voltmeter? A. You are correct in supposing that the amount of current registered on an ammeter connected in a circuit is dependent upon the voltage and resistance. In testing dry batteries, however, it is customary to short circuit each cell for an instant through an ammeter to see what is the maximum rate at which it will discharge. When new, this gives an indication of the capacity of the battery, and, as a cell becomes run down, the rate at which it will discharge when momentarily short-circuited decreases. When this falls to 5 amperes the cell is about used up for anything but very light, intermittent work. Cells in this condition will sometimes still spark a gasoline engine if the vibrator is properly adjusted to suit the weak current they will supply. The voltage also falls off slightly as a dry cell becomes run down, but this indication is not as definite as the amperes in the cell will show, while with a storage cell the voltage taken when the cell is discharging is a good criterion of the amount of charge still in the cell. A dry cell shows 1.5 volts when new and anywhere from 1 to 1.25 or possibly more when run down. A storage cell shows 2.1 or 2 volts under discharge when full, about 1.9 when half discharged, and 1.8 or 1.75 when fully discharged. It will, however, immediately return to 2 volts when on open circuit. In short-circuiting dry cells through an ammeter, but one cell at a time should be tested and care should be taken to have large enough wire to carry the current easily. The wires to the meter should be as short as possible and all connections should be well made. A whole battery of 4 or 6 cells can be short-circuited at once, but this gives an average discharge only and does not indicate the condition of each separate cell.

(10991) W. I. H. asks: 1. What is the heat conductivity of carbon such as the pencils used in arc lamps? What order does it have in the scale of conductors? A. The conductivity of carbon for heat is 0.000405, when copper is 1.0405 on the same scale. This is less than all the metals, stones, and many minerals, and more than most woods, wool, and animal substances generally. 2. What is its fusing point, or does it only fuse in the electric arc? A. Carbon has not been melted, though under sufficient pressure there seems to be no reason why it may not be melted. It turns or seems to turn directly into a vapor upon heating it sufficiently. It vaporizes in the electric arc at a temperature between 5,000 and 7,000 deg. F. The electric arc is the only source of heat hot enough to vaporize carbon. 3. What is its specific gravity? A. The specific gravity of carbon in the form of graphite is from 1.9 to 2.3. The porosity of electric light carbons would probably cause them to appear lighter than this. 4. How is it manufactured and of what is it composed? A. Carbon is manufactured from wood as charcoal; from coal in retorts as graphite. Carbon is carbon. It is an element, and so far as man is able to affect it, it is not made from any other substance, nor changed into any other substance. 5. What holds it together, that is, is it plastic when molded or molded under great pressure? A. Cohesion holds the particles of a lump of coal or other piece of carbon together. It is not plastic in its ordinary states. In the electric light carbons the particles are bound together by some sticky material, and the rod is then burned in a furnace. 6. Is it what would be considered an expensive product? Please give some idea of cost in molded shapes and in bulk. A. Carbon is not an expensive article. You know probably what a ton of coal or a cord of wood is worth at your place. In buying either you are buying carbon. 7. Could scraps of it be pulverized and again molded into shape? A. Pulverized gas carbon, or graphite, is molded, as we have said above. 8. Can you supply us with the addresses of firms making articles of carbon? A. Consult our Manufacturers' Index sent free on request. All dealers in electrical goods have electric-light carbons, battery plates, and motor brushes for sale. They also may have granular carbon for use in the telephone transmitter. Jewelers deal in diamonds, which are crystallized carbon. 9. All authorities do not agree upon the melting point of gold. Please tell the melting point both in Fahrenheit and Centigrade. A. The melting point of gold ranges from 1,035 to 1,250 deg. C.; 1,080 deg. may be taken as an average value. This is from 1,900 to 2,250 deg. F.

(10992) A. L. asks: Kindly oblige me by answering the following questions: 1. What is best material to make a magnet of? 2. What is the best means of making a magnet? 3. Does the north pole of a magnet repel the north pole of another magnet in practice the same as in theory? I mean on a large scale. A. Permanent magnets are made of steel, the best steel to be found. Tool steel is often used. See query No. 10987 on this page. Heat the bar to a cherry red, or if it is long, the ends of the bar, and plunge it endwise into water. It will then be glass hard. Draw the bar across the poles of a strong magnet, either another permanent magnet or, better, an electro-magnet. Do this ten to twenty times, pulling it off in the same direction from one pole, and then reverse the bar and pull the other end from the other pole in the same way. There is a repulsion between similar, and an attraction between opposite poles of two magnets. If the magnets be strong this will also be strong.

(10993) R. E. S. says: In your valuable paper, the SCIENTIFIC AMERICAN, of July 29, 1905, under the heading, "Five Thousand Degrees of Heat," I find these words: "We have a heat that cannot be surpassed, and we obtain, in fact, a heat of 5,000 deg." Now, are you aware of the fact that the Carborundum Company, of Niagara Falls, uses 7,000 degrees of heat in producing its so-called carborundum? A thousand horse-power of electric energy, furnished by Niagara, is said to be converted into over 7,000 degrees of heat. In fact the heat is said to be so intense that it burns and vaporizes every known element. I have heard, from various sources, that Thomas Edison, in trying to produce diamonds, led to the discovery and manufacture of carborundum. Carborundum is a mixture of sawdust, sand, and salt fused with coke at the tremendous heat of 7,000 deg. It is said to be diamond in character, of the same hardness, and even more indestructible. It is made up into wheels for grinding purposes and also made into hones and the like, and is, I assure you, absolutely the best grinding substance known. The above facts I take from a paper furnished by the Carborundum Company to one of its agents. A. We note your criticism of the phrase used by our Paris correspondent, "A heat of 5,000 deg." It is doubtless true that the electric arc furnishes the highest known temperature, and that this is the temperature at which carbon volatilizes. It is not so easy as you seem to assume it to be to determine just what that temperature is. A recent book on the electric furnace, by J. Wright, published 1905, contains this statement, page 9: "The temperature of the electric arc itself has never been determined." The highest authority in the world upon the electric furnace is without doubt Henri Moissan, of Paris. In his book, "The Electric Furnace," published July, 1904, page 19, he says, "We do not know the temperature of these pieces of apparatus; it depends upon the temperature reached by the electric arc which may be, according to Violle, 3,500 deg." This corresponds to 6,300 deg. F., since Violle used the Centigrade scale. The temperature of the electric arc is probably limited by the temperature at which carbon is volatilized. This has been variously estimated at from a little above 5,000 deg. F. to about 7,000 deg. F. In Chatelier's "High Temperature Measurements," published September, 1904, page 302, the "extreme temperature of the electric arc" is given at 3,600 deg. C., which is 6,500 deg. F. Wootham, in his book, published 1904, "Recent Development of Physical Science," page 77, gives the temperature of the electric arc as 3,000 to 4,000 deg. C., or 5,400 to 7,200 deg. F. We have given you the results as stated by the most reliable authorities. And we can say that we are not aware that it is certain that a temperature of 7,000 deg. exists in the electric furnace. It appears that our Paris correspondent used the lowest estimate of the temperature, while the advertising circular which you quote and which we have at hand uses the highest estimated temperature of the apparatus, as is natural that it should do. We do not know why our correspondent used the lowest figures, and personally we are accustomed to give both extremes when we use any figures on this point. One way or the other there is nothing to dispute about. If you will read the books we have quoted, especially the "High Temperature Measurements," which we can furnish for $3, you will appreciate the work done in this direction and the difficulties of the problem. Moissan's "Electric Furnace"

is also a book well worth reading by any one who would know the facts in the matter. We send it for $3. This book contains the full history of the effort to produce diamonds artificially, in which Moissan has been the chief experimenter and the most successful one. It may be that Mr. Edison has taken a hand in this line of work, since he has done so in almost every line, but his name has not been publicly associated with the artificial production of diamonds. Your sources of information in the matter may be better than ours. The invention of carborundum is credited to Mr. E. G. Acheson in 1893. Moissan, "Electric Furnace," page 264, says: "I had occasion to find, in 1891, . . . small crystals of a silicide of carbon. . . . I did not, however, publish anything on this subject at the time, and the discovery of the crystallized carbon silicide really belongs to Acheson." It is not "diamond in character," as you state, since the diamond is simply crystallized carbon, while carborundum is a compound of silicon and carbon. It is next to the diamond in hardness, or between 9 and 10 on the mineral scale of hardness. Being harder than emery it is a better abrasive, although emery is still preferred by some.

NEW BOOKS, ETC.

MAN IN THE LIGHT OF EVOLUTION. By John M. Tyler, Ph.D. New York: D. Appleton & Co., 1908. 12mo.; pp. 231. Price, $1.25.

It is now about fifty years since Mr. Darwin published "The Origin of Species." A host of books have since been written on evolution, Darwinism, and natural selection, but comparatively few zoologists have attempted to show the bearing of the theory of evolution on man's history, progress, and life. They have usually left this problem to the sociologist and the archæologist. The author has attempted to mark out a straight and narrow path through the subject. He has viewed animals and man more from the physiological than from the anatomical standpoint. Much is said of functions, powers, actions; less of organs and structure.

SUBJECT LIST OF WORKS OF REFERENCE, BIOGRAPHY, BIBLIOGRAPHY, THE AUXILIARY HISTORICAL SCIENCES IN THE LIBRARY OF THE (BRITISH) PATENT OFFICE. London: His Majesty's Stationery Office, 1908. 18mo.; 336 pages. Price, 6 pence.

An admirable addition to a most useful little series of bibliographical handbooks.

GAS ENGINE MANUAL. By W. A. Tookey. London: Percival Marshall & Co., 1908. 12mo.; pp. 186. Price, $1.50.

There always seems to be room for a book on gas engines, although some fifteen or twenty years ago the literature on the subject was extremely meager. The introduction of the automobile has caused widespread interest in internal combustion motors. Some years ago the author produced several small handbooks which met with favor, and since that time he has been asked repeatedly to write a small, comprehensive work on the gas engine, which would form a stepping stone from these handbooks to more scientific treatises. He has devoted special attention to the nature of disturbances which usually affect the performance of gas engines when erected permanently in factories, which to a practical engineer is of more value than treatises dealing with the theoretical consideration of scientific research, or "test bed" experiments. A special feature of the book is a series of indicated diagrams, most of which are reproduced from actual cards taken by the author in everyday work.

HALLEY'S COMET. An Evening Discourse to the British Association at Their Meeting at Dublin on Friday, September 4, 1908. By H. H. Turner, D.Sc., F.R.S. Oxford: Clarendon Press, 1908. 8vo.; 32 pages.

In this paper Prof. Turner has presented a very excellent astronomical history of Halley's famous comet. He gives all the records of its former appearances.

ECONOMIC ZOOLOGY. An Introductory Textbook in Zoology. By Herbert Osborn, M.Sc. New York: The Macmillan Company, 1908. 12mo.; pp. 490. Price, $2.

This book is not intended merely as a textbook for a school or college student, but it is hoped that it may be of service to that very interesting body of citizens who wish to familiarize themselves with the general principles and the present status of knowledge regarding the animal kingdom. Zoology when presented in such a lucid form as in the present work can be made very attractive. The book is admirably illustrated by 269 engravings.

THE PSYCHOLOGY OF ADVERTISING. By Walter Dill Scott, Ph.D. Boston: Small, Maynard & Co., 1908. 12mo.; pp. 269. Price, $2.

A most valuable book written by an expert, who brings the psychological laboratory into one phase of modern business life. The typical business man is an optimist. For him the future is full of possibilities that never have been aroused in the past. He is not, however, a day-dreamer, but one who uses his imagination in formulating plans which lead to immediate action. The advertiser may well be regarded as typical of the class of American business men. At the time when advertisements were poorly constructed and given limited circulation, certain enterprising men saw the possibilities of advertising, and began systematically to improve the whole profession of advertising. There is a vast difference between the advertisements of twenty-five years ago and to-day. It is not strange that advertising has as its one function the influencing of the human mind. Unless it does this, it is useless and destructive to the firms attempting it. As it is, the human mind in advertising is dealing with its only scientific basis in psychology, which is simply a systematic study of those same minds which the advertiser is seeking to influence. This fact was seen by wise advertisers, and some ten years ago various theories of advertising began to be reduced to concrete form. The author has produced a critical work dealing with memory, human instincts, suggestions, will, habit, laws of progressive thinking, attention to the value of spaces, psychology of food advertising, railway advertising, etc. It is an excellent book accompanied by a full bibliography.

COLOR VALUE. By C. R. Clifford. New York: Clifford & Lawton, 1908. 8vo.; 95 pages. Price, $1.

An admirable volume filled with good suggestions which will be of the greatest service to all interior decorators. It is a scientific treatise in every sense of the word. Its study will prevent the hideous combinations which offend the refined taste in so many houses.

DIE SAEUGETIERE DES DEUTSCHEN WALDES. Von Dr. Kurt Floericke. Mit Bildern. Octavo. Stuttgart: Kosmos Gesellschaft der Naturfreunde, 1908. Pp. 105. Price, 50 cents.

Dr. Floericke's book on the animals of the German forest is one of the popular series of nature books which have long been published by the well-known German scientific periodical Kosmos. The book is a simple, straightforward account, which should be read with interest by those who have no desire to penetrate deeply into natural history, but who want an intelligible, accurate, and non-technical book on the subject. With the exception of an attempt at fine writing, which seems to be inevitable in all popular works, the book strikes us as an accurate and careful presentation of the subject.

EXPERIMENTAL ELASTICITY. A Manual for the Laboratory. By G. F. C. Searle, M.A., F.R.S., Cambridge (England). New York: G. P. Putnam's Sons, 1908. 12mo.; 187 pages. Price, $1.50.

A highly specialized treatise which will be warmly welcomed by all physicists. The subject is an interesting one and is admirably treated.

CEMENT HOUSES AND HOW TO BUILD THEM. By W. A. Radford. Chicago and New York: Radford Architectural Company, 1908. Small quarto; Pp. 158. Price, $1.

This is a practical treatise on the construction of cement houses, giving standard specifications for cement, standard specifications for concrete blocks, general information concerning waterproofing, coloring, paving, reinforcing, foundations, walls, steps, sewer pipes, chimneys, porches, floors, the use of concrete on the farm, with perspective views and floor plans of concrete block and cement plaster houses.

ELECTRIC FURNACES. The Production of Heat from Electrical Energy and the Construction of Electrical Furnaces. By Wilhelm Borchers. Translated by Henry G. Solomon, A.M.I.E.E. London and New York: Longmans, Green & Co., 1908. 8vo.; Pp. 224. Price, $2.50.

The present volume is an English version of the second German edition of "Die Elektrischen Oefen" by Dr. Borchers, the well-known authority on electro-metallurgy. The recent rapid development, notably abroad, of the electric furnace is sufficient to prove how important a part it is playing, and is destined to play in a still greater degree in the near future in connection with all classes of metallurgical operations. By the aid of electric furnaces it should be possible to develop new industries and in districts hitherto unsuitable for electrical enterprise, especially where the raw materials are readily obtainable for the production of the substances desired and current can be cheaply generated and supplied, as by the utilization of waste furnace gases and overhead transmission. To those who are comparatively familiar with the subject of electro-metallurgy, this book will prove a revelation. It is filled with the most interesting illustrations, numbering 279 in all. It is a book which we can heartily commend.

NAUTICAL CHARTS. By G. R. Putnam, M.S. New York: John Wiley & Sons, 1908. 8vo.; Pp. 162. Price, $2.

This is the first work on an important subject. In all the countries of the world, more than a million copies of charts are now issued annually. A considerable portion of the human race are interested directly or indirectly, either as mariners or passengers, or shippers on the sea. Aside from supplying a handbook for those who might have a general interest in the subject, it was thought that a discussion of charts might lead to a further consideration of the principles governing their construction. It is an excellent work well illustrated and well printed.

MERCK'S 1907 INDEX. Third edition. New York: Merck & Co., 1907. 8vo.; 472 pages. Price, $5.

An encyclopedia for the chemist, pharmacist, and physician, stating the names and synonyms, source or origin, chemical nature and formulas, physical form, appearance, and properties, melting and boiling points, solubilities, specific gravities and methods of testing, physiological effects, therapeutic uses, modes of administration and application, ordinary and maximum doses, incompatibles, antidotes, special cautions, hints on keeping and handling, etc., of the chemicals and drugs used in chemistry, medicine, and the arts. It is a chemical encyclopedia. But whereas Beilstein takes in all possible combinations, Merck's 1907 Index limits itself to the chemicals and drugs actually on the market, giving in regard to them information comparable to Beilstein's. This latest edition is improved by the addition of the newest products of the chemical industry, by the adoption of the latest nomenclature, by the adherence to the most modern authorities. We have used older editions with much satisfaction. It is indispensable for the editor's desk.

MODERN PRACTICE IN MINING. Vol. 1. Coal, Its Occurrence, Value, and Methods of Boring. By R. A. S. Redmayne. London and New York: Longmans, Green & Co., 1908. 8vo.; Pp. 199. Price, $2.

The present volume is the predecessor of several others which are to be brought out in successive order, the series constituting a complete work on modern practice in mining. While the British colliery practice is somewhat different than that in vogue in America, still the present work contains enough valuable information to warrant its purchase by any who are in any way interested in coal mining. Special attention is given to prospecting and boring for coal. In fact, this constitutes the largest part of the book. It is well illustrated by numerous engravings.

EX-MERIDIAN, ALTITUDE, AZIMUTH, AND STAR-FINDING TABLES. By Lieut. Com. Armistead Rust. New York: John Wiley & Sons, 1908. 8vo.; Pp. 393. Price, $5.

All navigators will be interested in this book. It is not a textbook, no space being taken up by rules for the conversion of time, the finding of hour angles, and for plotting lines of position by the usual methods familiar to navigators, which may be found in any work on navigation. The book is a most commendable specimen of industry.

HEATING AND VENTILATION. By Charles L. Hubbard, S.B., M.E. Chicago: American School of Correspondence, 1908. 8vo.; pp. 221. Price, $1.50.

In recent years such marvelous advances have been made in the engineering and scientific fields, and so rapid has been the evolution of mechanical and constructive processes and methods, that a distinct need has been created for a series of practical working guides of convenient size and low cost, embodying the accumulative results of experience and the most approved modern practice along a great variety of lines. To fill this acknowledged need is the special purpose of a series of hand-books to which this volume belongs. The volume is particularly adapted to the purpose of self-instruction and home study. The utmost care has been used to bring the treatment of each subject within the range of the common understanding, so that the work will appeal not only to the trained expert, but also to the beginner and to the self-taught practical man who wishes to keep abreast of modern progress. The method adopted in the preparation of this volume is that which the American School of Correspondence has developed and employed so successfully for many years. The book is excellently illustrated.

MECHANICAL PRODUCTION OF COLD. By J. A. Ewing, C.B., LL.D., F.R.S. Cambridge, England: University Press, 1908. G. P. Putnam's Sons, Importers, 1908. 8vo.; pp. 204. Price, $3.25.

This book is a reprint of lectures on the mechanical production of cold delivered before the Society of Arts in 1897, with additions and corrections which show the advance of the past eleven years, and bring the accounts of machines and processes into accord with the practice of the day. In its main feature the art of refrigeration has undergone little change in that time, but notable progress has been made in some directions, and this has required the introduction of a good deal of supplementary matter. The refrigerating machine is essentially a contrivance for pumping up heat from a place that is comparatively cold to a place that is comparatively warm, and the question of primary interest is how to do this pumping with the least expenditure of power. We are concerned with the theoretical limits to the economy of power that hold in ideal refrigerating processes, and with considerations as to how nearly the actual conditions under which refrigeration is carried out will allow these limits to be approached when one or another type of real machine is employed. The lectures are in great part an attempt to make this side of the subject intelligible without unnecessary mathematics. The book is excellently illustrated.

SEWER CONSTRUCTION. By Henry N. Ogden, C.E. New York: John Wiley & Sons, 1908. 8vo.; pp. 335; 192 figures. Cloth, $3.

The course represents the second part of a year's work, of which the book on "Sewer Design," already published, is the first part, and it is assumed that the reader is familiar with that volume. The work appears to be an excellent one, and is deserving of a good sale among those interested in the subject.

MASSING OF SPHERES. A Geometrical Demonstration of the Constitution of Matter. By G. J. Stevens. London: J. Haslam Company, Ltd., 1908. 4to.; pp. 21. Price, $1.

THE LETTERS OF JENNIE ALLEN TO HER FRIEND, MISS MUSGROVE. By Grace Donworth. Boston: Small & Maynard Company, 1908. 12mo.; pp. 291. Price, $1.50.

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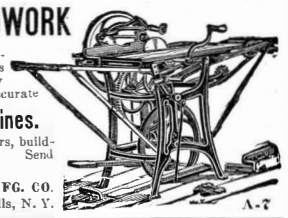

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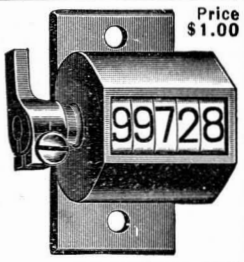

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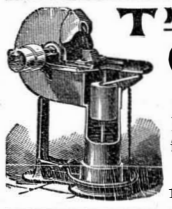

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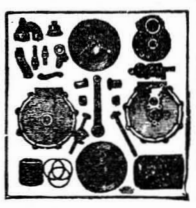

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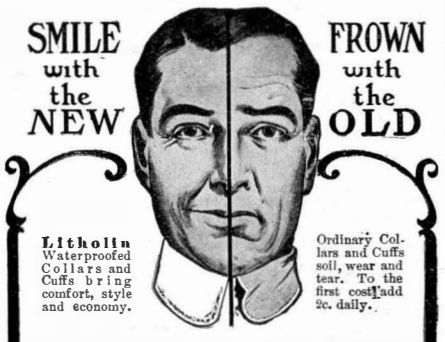
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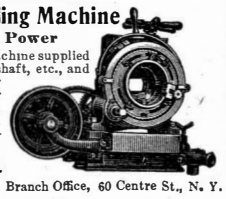

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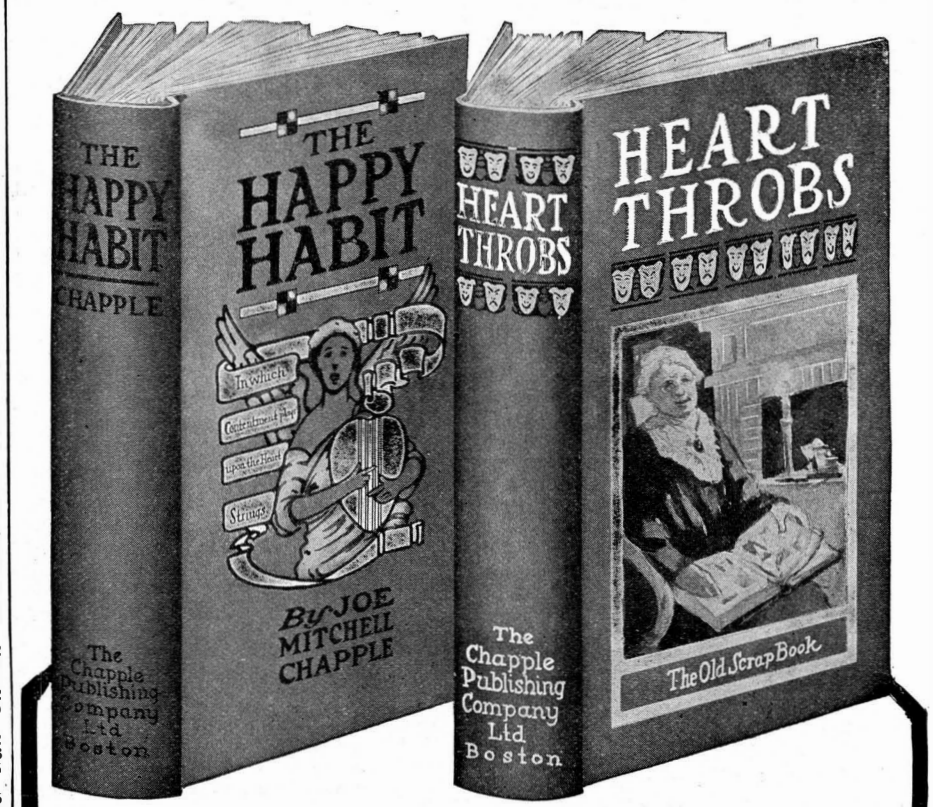

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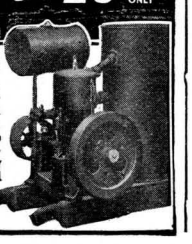

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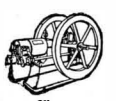

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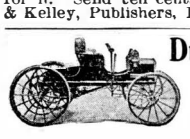

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"The Fire-Pen Cork Handle," for a gas pyrographic pen, H. M. Holton	14,458
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"The Marquetry Puzzle Picture," for picture puzzles, M. Rubens	14,457

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"Interchangeable Portable Office Partition," for bank and office partitions, Manhattan Office Partition Company	2,374
"Made to Eat—Not to Keep," for candy, Huyler's	2,371
"Milwaukee Harvesting Machines," for harvesting machines, Hayes Lithographic Co.	2,375
"The Eternal Question," for gelatin, Crystal Gelatine Co.	2,372

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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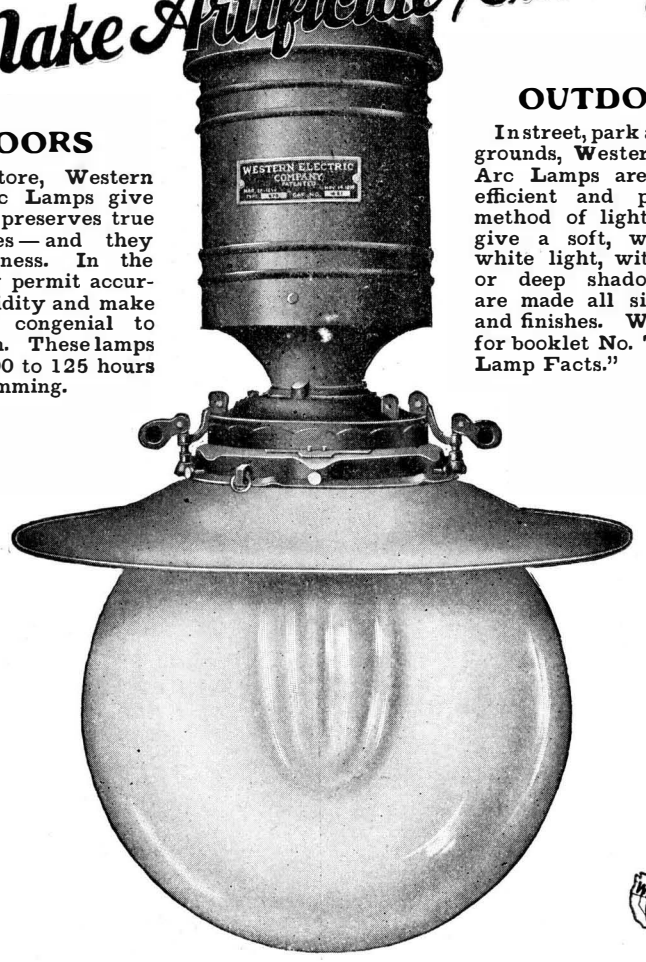

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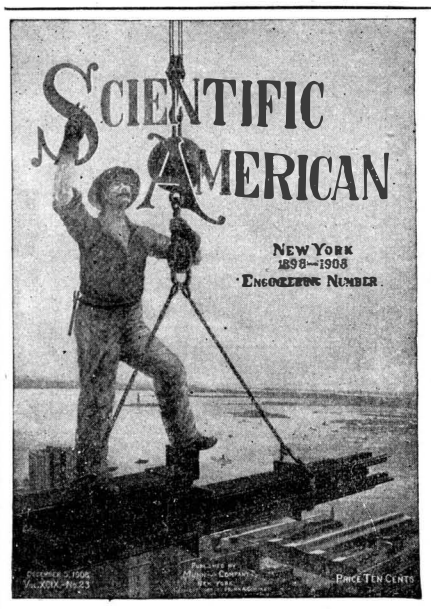

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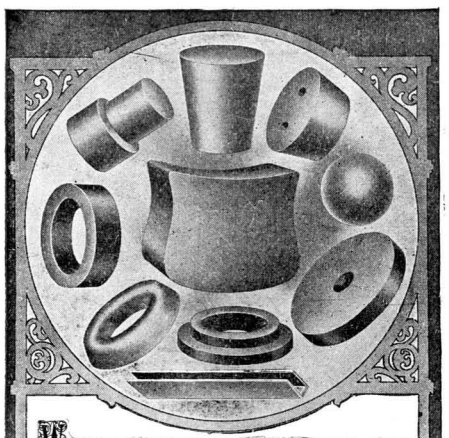

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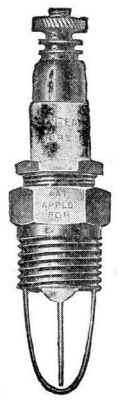

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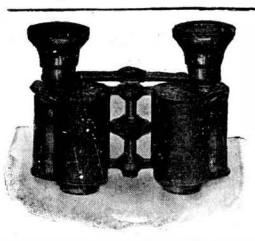

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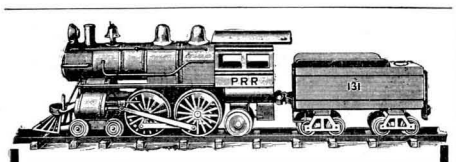

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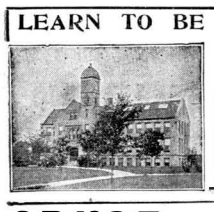

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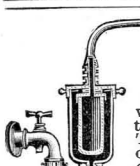

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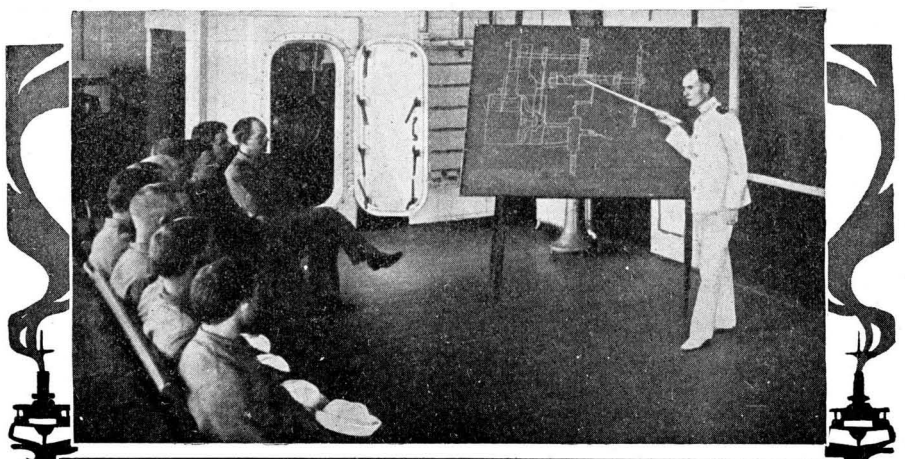

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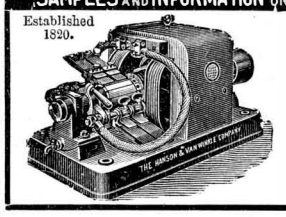

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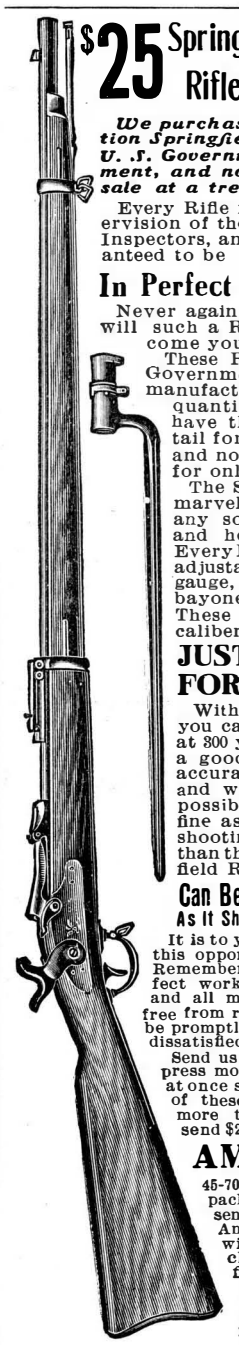

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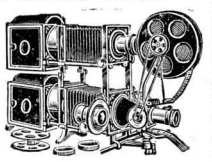

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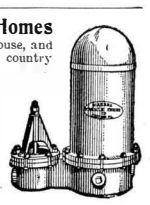

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